

**AN EVALUATION OF A NATIONAL CURRICULUM DOCUMENT**

***CHEMISTRY IN THE NEW ZEALAND CURRICULUM***

---

**A thesis**  
**submitted in partial fulfilment**  
**of the requirements for the Degree**  
**of**  
**Master of Science Education**  
**in the**  
**University of Canterbury**

---

**Tim Oughton**

**May 1999**

# CONTENTS

Chapter	Page
<b>Abstract</b>	
<b>1. Introduction</b>	
1.1 The development of <i>CINZC</i>	1
1.2 The writing of <i>CINZC</i>	5
1.3 Teachers and change	7
1.4 Research questions	9
<b>2. Method of Evaluation</b>	
2.1 Rationale	10
2.2 Sample selection	10
2.3 Questionnaire design	12
2.4 Interview questions	13
2.5 Data analysis	13
<b>3. Results</b>	
3.1 Description of respondents	14
3.2 Other background data	16
3.3 Curriculum Evaluation	
(i) Summary statistics for all respondents	17
(ii) Summary statistics for females and males	28
(iii) Summary statistics for other groups	32
3.4 Interview summaries and emerging themes	49
<b>4. Summary conclusions and recommendations</b>	
4.1 Usefulness of <i>CINZC</i> to the classroom teacher	56
5.2 Differences in level of support	56
4.3 Implementation of <i>CINZC</i> and teacher change	57
4.4 Barriers to successful implementation of <i>CINZC</i>	58
4.5 Personal reflections	58
4.6 Recommendations	59
<b>References</b>	61
<b>Appendices</b>	63

## LIST OF TABLES

TABLE	PAGE
1. The distribution of respondents by school size, region, authority and gender	10
2. Backgrounds of teachers interviewed	10
3. Description of the background of the respondents	13
4. Statistical sum of information from 'value scale' questions	17
5. Summary of amount described at each Achievement Level	25
6. Biographical gender differences	31
7. Statistical comparison of male and female responses from value scales	33

## LIST OF FIGURES

FIGURE	PAGE
1. Determinant of teaching style in Year 12 and Year 13	26
2. Barriers to implementation of <i>CINZC</i>	29
3. General agreement with overall philosophy of <i>CINZC</i>	34
4. <i>CINZC</i> 's usefulness for planning a chemistry programme	35
5. <i>CINZC</i> 's usefulness for assessing a chemistry programme	35
6. <i>CINZC</i> 's usefulness as a guide to classroom practice	36
7. Usefulness of <i>CINZC</i> 's Achievement Aims for planning, assessing, and teaching a chemistry programme	36
8. Usefulness of <i>CINZC</i> 's Achievement Objectives for planning, assessing, and teaching a chemistry programme	37
9. Usefulness of <i>CINZC</i> 's assessment Examples for planning, assessing, and teaching a chemistry programme	37
10. Usefulness of <i>CINZC</i> 's Developing Skills and Attitudes for planning, assessing, and teaching a chemistry programme	38
11. Approval of <i>CINZC</i> 's specific emphasis on the interaction between people, chemistry and the environment	38
12. Attempt to incorporate the philosophy and direction given by <i>CINZC</i> into the respondent's teaching programme	39
13. Success in implementing <i>CINZC</i> at the respondent's school	39
14. Overall feeling about <i>CINZC</i> as the platform for teaching and learning in the senior school	40
15. Primary determinant of teaching style in a Year 12 chemistry programme	40
16. Age group difference; Agreement with <i>CINZC</i> philosophy	42



17.	Age group difference; Degree of success in implementing <i>CINZC</i>	42
18.	Age group difference; Overall feeling about <i>CINZC</i> being the platform for chemistry teaching in the senior school	47
19.	School gender differences; Agreement with <i>CINZC</i> philosophy	44
20.	School gender differences; Degree of success in implementing <i>CINZC</i>	44
21.	School gender differences; Overall feeling about <i>CINZIC</i> being the platform for chemistry teaching and learning	45
22.	School size differences: Agreement with <i>CINZC</i> philosophy	46
23.	School size differences; Degree of success in implementing <i>CINZC</i>	46
24.	School size differences; Overall feeling about <i>CINZIC</i> being the platform for chemistry teaching and learning	47

## ACKNOWLEDGEMENTS

I would like to express my sincere thanks and appreciation to Dr Alison Gilmore and Dr Bryce Williamson from the University of Canterbury for their advice, encouragement, tolerance, and support over the unusually long period it took to complete this research project. Circumstances dictated that the project had to be suspended for one year and my supervisors' quiet determination to ensure that completion was a reality provided necessary inspiration at times. Special thanks also to Wendy Williamson for her patience and skill in teaching me the finer points of database manipulation.

I am also indebted to the many teachers who so willingly gave up their time to complete the questionnaires and participate in the interviews. I trust the information gathered from schools throughout New Zealand can be used to improve the conditions to teach chemistry.

Finally I would like to thank my family for their tolerance and cheerful cajoling over the past two years. The amount of time required to complete this project was far greater than ever anticipated and a special thank-you goes to my wife, Heather, who never failed to support my studies.

Tim Oughton  
Christchurch  
April 1999.

## ABSTRACT

Before the introduction of *Chemistry in the New Zealand Curriculum* (CINZC) in 1995 the teaching of chemistry in New Zealand schools had largely been determined by School Certificate and Bursary examination prescriptions and a national Sixth Form Certificate syllabus. The directive given by the then Secretary for Education was that CINZC should provide the basis for development of teaching programmes and that the Achievement Aims and Objectives would be used in the development of future examination prescriptions and alternative assessment systems. The major purpose of the research presented in this thesis was to determine the extent to which CINZC has influenced teaching approaches in schools, how useful the curriculum has been to teachers, the level of support for the curriculum from teachers with different backgrounds, and to determine the major barriers or tensions that could affect successful implementation.

A questionnaire was sent to a sample of secondary schools throughout New Zealand. The data collected were analysed and used to frame questions to be used in comprehensive interviews with six Christchurch chemistry teachers. The results indicated that, while a great majority of chemistry teachers agree with the philosophy and intent of CINZC implementation had been only partially successful in schools and several barriers existed, notably insufficient time and inadequate written and human resources.

One very significant finding related to the differences in attitude and support for CINZC by male and female respondents. Females were generally more supportive and positive than their male counterparts. Differences between teachers of different age groups, school gender and school size were less notable.

Several recommendations are made as a result of these findings. The most important immediate need is for a teacher's guide to be produced that fills in the detail many teachers are seeking. Allied to this resource is the need for a comprehensive teacher development programme to assist implementation

# CHAPTER 1

## INTRODUCTION

### 1.1 The Development of Chemistry in the New Zealand Curriculum

Chemistry owes much of its early development to alchemy. Alchemists were not perceived to be true scientists, but rather magicians or mystics. By the 15th Century their efforts were chiefly focused in two areas; finding a cure for diseases and discovering a way to turn 'base metals' into gold. As the scientific revolution spread, sparked by the works of Galileo and Newton, and later Lavoisier in chemistry, the practice of alchemy ceased. However, it left as its legacy knowledge of many chemical substances and a variety of methods of extraction (Christiansen and Garrett, 1960). Chemistry was gradually introduced as a university subject, although until the middle of the 18th Century it was only regarded as an adjunct of medicine. From 1750 on, chemistry became a subject in its own right and Chairs in Chemistry were established in universities as industrial pressure demanded a supply of analysts and research chemists (Johnstone, 1993).

During the 19th Century chemistry was introduced into high schools to fill a vocational rather than an intellectual need. It was not until the 20th Century that it was recognised as a subject that could contribute to the training of the mind. The chemistry curriculum was mainly concerned with the 'preparation and properties of gases, a list of laws and definitions, ...a few industrial processes with details of temperatures and pressures, ... practical work consisting of observations of preparations and properties and analytical exercises of varying complexity', in other words a lot of rote learning and regurgitation interspersed with a few demonstrations (Johnstone, 1993, p 702). Unfortunately, the situation did not change for a number of years.

James Conant, in his book *On Understanding Science* (1947) argued that scientists invent and use conceptual schemes and that these are modified over time and may even be discarded. This shift away from the observational philosophy of science towards conceptual modification and refinement (Novak, 1984) began the questioning about the relevance of what was being taught in school chemistry generally. Although chemistry curriculum revision was frequently discussed in both the United Kingdom and the United States, little change occurred, largely because of a lack of funding. However, in 1957 with the launch of Sputnik and the subsequent cold-war race for space supremacy, the immediate demand for more scientists resulted in funding being made available. In chemistry the Nuffield Chemistry programme was developed in the U.K. and was paralleled by similar developments in the U.S. where the Chemical Bond Approach and the CHEM Study programme were two of the most popular curricula. In all these cases, there was a major change away from the rote learning of individual reactions and a move towards a more conceptual approach, that is, one 'in which the fundamental, unifying concepts of chemistry are stressed' (Merrill, 1969, p 412). At the same time, individual practical work was accorded considerable importance with

the 'discovery' approach (Ausubel, 1969), where students were encouraged to plan their own experimental work and hopefully derive or discover the concepts of chemistry for themselves.

A new chemistry curriculum for New Zealand was produced in 1967 and was influenced by the U.K. and U.S. conceptually driven approaches. The textbook used by the majority of New Zealand schools at that time was the CHEM Study resource, *Chemistry: An Experimental Science* (1960). Despite the short-term growth in numbers of students studying chemistry at both the secondary and tertiary levels, it soon became obvious to teachers that their own enthusiasm for the new curriculum was not being matched by their students, and falling numbers in high school classes and university resulted. Clark and Vere-Jones (1987) found that in the eleven years from 1974 to 1986 there was a significant drop in the number of boys taking senior chemistry and only a slight rise in the number of girls. Harland (1991) reported that the Bursary entrance figures indicated that chemistry had the lowest growth rate of all the sciences over the preceding decade, despite increasing numbers of students in the senior high school. As Johnstone (1993, p 413) stated 'The sad fact was that we did not produce a generation of people thirsting for chemical knowledge'.

The next, and most recent, curriculum directions in science and chemistry education have been influenced largely by questioning the process of learning and, in particular, by research on what was being taught and whether it was being learnt. Piaget asserted that the child did not acquire knowledge merely by being told or by reading about it, rather that the child must act on the knowledge (Mallison, 1975). In the late 1970s and early 1980s, research projects in several countries were established to investigate children's learning in science. The Project to Enhance Effective Learning (PEEL) study of Monash University (Melbourne), directed by White and Gunston, set out to 'develop methods of probing students' understanding and to see how alternative conceptions of phenomena held by students could be brought into accord with scientists conceptions' (White, 1988, p 121). The work of the Childrens' Learning in Science Project (CLISP) at Leeds University in the U.K., directed by Roselind Driver, and the work of the Learning in Science Project (LISP) at Waikato University, headed by Osborne and Freyberg, used extensive individual student interviews, surveys and observations to find out the students' views of the various phenomena in science (Schollum, 1992). All of these studies clearly demonstrated that childrens' learning in science is an investigative constructive process. Research in this field 'seeks, in various contexts, to define condition that promote optimal students' enquiry', and the teaching 'that can provide those conditions. The general philosophy that supports this view has come to be called constructivism' (Hawkins, 1994, p 13).

Many cognitive scientists now believe in a constructivist model of knowledge that attempts to answer the primary question of epistemology, "How do we come to know what we know?" This constructivist model can be summarised in a single statement: 'Knowledge is constructed in the mind of the learner.' (Bodner, 1986, p 873)

In the constructivist model students are perceived as active learners who come to chemistry lessons with pre-conceived ideas about natural phenomena which they use to make sense of their everyday experiences.

To the teacher, the challenge that underpins a constructivist approach is 'to help students make better sense of their world, leading to better understanding of the '1concepts of the scientist' (Carr, 1995, p 11).

In 1984 a national curriculum review for schools was established by the recently appointed Minister of Education. The public discussion and consultation was considerable, with over 20,000 initial submissions. The review committee, which included representatives from the main educational groups, interpreted the curriculum to be 'all the activities, events, and experiences that take place in the schools learning programme' (Department of Education, 1987 p 5). This was a different interpretation of the previous notion of a syllabus or examination prescription which prescribes the content to be learnt and examined. The report contained advice to the Minister on the basis for curriculum design and, in particular, that

- there be a national common curriculum for all schools from new entrants to Form 5.
- the national common curriculum provide for a broad and general education and consist of
  - a. national curriculum principles;
  - b. three inter-related aspects of learning, knowledge, skills, and attitudes and values.
- the national common curriculum be given status by regulation.
- each school have responsibility to develop a school curriculum consistent with the national curriculum.
- the programmes in Forms 6 and 7 be developed from the national common curriculum.

In 1988 a Draft National Curriculum Statement was written in response to the recommendation that there be a common national curriculum for schools. Science, as one of the recommended core curriculum areas, was already under review (Bell, 1990). A new draft science syllabus for students in forms 1-5 was written over the four years 1985 - 1989. The main underlying theoretical perspective for this draft syllabus was a constructivist view of learning and was a departure from previous syllabus statements which were largely hierarchical and based on defined content levels (Bell, Jones and Carr, 1995). Despite receiving support from the New Zealand Science Teachers' Association, the teacher unions and the Ministerial Task Group reviewing science, the draft science syllabus was neither ratified nor distributed widely.

A change of government in 1989 resulted in a radical change in the process of curriculum development, beginning with the disestablishment of the Curriculum Development Division and subsequent contracting out of curriculum development to interested parties. In May 1991, an advertisement was published by the Ministry of Education inviting people to register interest in being contracted to write a new science curriculum. The successful applicant in science was expected to have an in-depth knowledge of current syllabii, familiarity with research in science education and be able to coordinate a working group of science educators. The contract specified that the writing of the draft document be completed in a specified period (four months, later extended to six) and that interested groups were to be consulted and incorporated into

the development processes. The universities, which were previously involved through the former University Entrance Board, did not have a direct influence, although they were represented as individuals on reference groups and on the Policy Advisory Group.

The process was monitored by both the Minister of Education's Policy Advisory Group (Science) and by the Ministry of Education's Science Curriculum Contract Review Group. The two groups had similar but different roles. The Policy Advisory Group commented on the material produced and suggested 'policy advice' for the Minister on the document itself and on implementation issues such as resources and teacher development. The Review Group also commented on the material produced but with respect to whether the terms of the contract had or had not been met. Writing began in August 1991 and, after the cycling of five working papers through the consultative process, a final draft appeared in schools at the end of April in 1992. Teachers were requested to send comments and submissions to the Ministry of Education. After a delay caused by a moratorium placed on curriculum development by the Post Primary Teachers' Association (because of opposition to the bulk funding of teachers' salaries) a final document was presented to the Policy Advisory Group in August 1993, and released to schools a month later (Haig, 1995).

The new science curriculum differed from the previous syllabii in that it covered the requirements for science education from ages 5-17 (Levels 1-8). In addition, science as a subject (as distinct from the separate science subjects of biology, chemistry and physics) had not existed previously in the senior secondary school. The structure of the science curriculum was determined by the New Zealand Curriculum Framework (Ministry of Education, 1993), which described science as one of the seven broad essential learning areas. The essential learning area of science includes the subjects of science, biology, chemistry, physics, earth sciences, agriculture and horticulture. The New Zealand Curriculum Framework requires that all national curriculum statements in the essential learning areas specify clear learning outcomes against which students' achievements can be assessed. These learning outcomes or objectives must be defined over eight progressive levels and be grouped into a number of strands. In the science curriculum there are two types of learning strands – the integrating strands and the contextual strands. The integrating strands are:

- Making sense of the nature of science and its relationship to technology;
- Developing scientific skills and attitudes.

The contextual strands are:

- Making sense of the living world;
- Making sense of the physical world;
- Making sense of the material world;
- Making sense of Planet Earth and beyond.

Considerable debate followed the use of the term 'making sense' as a stem to the four contextual strands (Irwin, 1994; Matthews, 1995). Matthews argued that scientific knowledge would be downgraded to the extent that if a student could make any sense of a concept then common sense could account for anything. Haig (1995), the coordinating writer of the science curriculum, argued that 'making sense' was to mean the development of understanding of scientific knowledge. The writers and the

reviewers considered that the value of using the phrase 'making sense' lay in the emphasis it placed on the requirement for students to be actively engaged in mental processes that lead to understanding scientific ideas rather than to memorising scientific information.

The model used to develop *Science in the New Zealand Curriculum* was very similar to that used in the development of *Chemistry in the New Zealand Curriculum*. The first phase involved a writing group\* developing, under contract, a draft statement in consultation with a reference group and in response to the critical comment on working drafts from a Ministry appointed review committee. The second phase involved the analysis of written feedback from interested groups and individuals. The final phase involved a second writing contract and the revision of the draft curriculum statement in accordance with a brief based on the outcome of the second phase. The structural framework of *Chemistry in the New Zealand Curriculum* had largely been determined before the writing process began and followed an identical design to that used in *Science in the New Zealand Curriculum*. Ministry direction was given regarding the importance of making the chemistry curriculum suitable for all students, regardless of whether or not they would pursue chemistry at the tertiary level (Tasker, 1994). Supporting resources were promised by the Ministry of Education for *Chemistry in the New Zealand Curriculum* although they remain, as yet, unwritten.

## **1.2 The writing of Chemistry in the New Zealand Curriculum**

The first phase of the writing process began in January 1993 and was completed in October the same year. In November, a draft curriculum statement was produced and circulated amongst schools, universities, polytechnics and professional associations. Feedback was encouraged and 35 submissions in total were received from various sectors:

- 17 from individuals
- three from school chemistry departments
- five from tertiary institutions
- ten from professional groups, such as science teachers' associations and the New Zealand Institute of Chemistry.

The analysis of the submissions was carried out by the Ministry of Education and a summary report was then presented to the Minister's advisory groups who had to prepare a brief for the second phase. Because the respondents were free to comment on anything they chose it was not really possible to say with any confidence how many supported or rejected particular aspects of the document or the entire document itself (Oughton, 1995).

---

\* The principal writers were: Loanne Metcalfe, Villa Maria College; Tim Oughton, Christchurch College of Education; Graeme Tinkler, Cashmere High School.



However two major concerns came through clearly. They were

- (i) the vagueness and lack of detail;
- (ii) the “woolly” language and lack of obvious progression associated with the objectives at each Achievement Level.

The draft was perceived by many as being little more than a statement of pedagogy and learning theory. To be of more use to the classroom teacher it needed to have clear statements about the content that should be taught at each level.

Many were sympathetic towards the intent and direction of the draft but wanted a more specific document. The majority commented on ‘an under-emphasis of content’ and others wanted more direction without being prescriptive. Many found the possible learning experiences interesting and useful, and supported the emphasis on practical work. However, very little of this support came without the following provisos:

- detailed teacher support material must be made available;
- teacher training must be provided with respect to the possible learning experiences and increased emphasis on practical work;
- schools should have equal access to libraries, databases, industry support and specialist equipment;
- detailed information should be made available advising teachers on safety requirements for new practical work. (Oughton, 1995)

Among the numerous recommendations made by Ministry for the preparation for the final document was the significant change in direction in terms of structure and philosophy of the science curriculum, regarding the place of content in the curriculum. Broad content areas were to be defined for each achievement level using the important concepts and major patterns outlined in Achievement Aim 3 ( *CINZC*, p. 19) as a guide. In this regard, the chemistry curriculum could be considered to be moving away from a constructivist philosophy. This recommendation was welcomed by many chemistry teachers (Oughton, 1995) but questions like ‘how broad is broad?’ and ‘to what extent does a curriculum statement need to prescribe examination content?’ were not easy to answer when little or no guidance was given by the advisory groups.

The final curriculum statement was printed in October 1994 and distributed to schools. In a letter sent out with *Chemistry in the New Zealand Curriculum*, teachers were encouraged by the then Secretary for Education, Dr Maris O’Rourke, to use the curriculum statement to “provide the basis for the further development of teaching programmes in chemistry in the senior school”. Further “the achievement aims and objectives will be used by the Qualifications Authority in the development of Unit Standards and new examination prescriptions”.

Full implementation of the new curriculum was to be carried out in schools by the beginning of 1998. Although the curriculum cannot be officially gazetted since, according to the Ministry of Education, chemistry is not a compulsory subject in the senior school, it is still expected that the Education Review Office will report on learning programmes derived from national curriculum statements. Schools teaching chemistry must, therefore, use *Chemistry in the New Zealand Curriculum* as the cornerstone of their teaching and learning programmes. The recent development of

Chemistry Unit Standards within the National Qualifications Framework has, without doubt, influenced the workload of teachers and the subsequent delivery of chemistry courses in those schools that have chosen to be part of the initial implementation. Although the Chemistry Unit Standards have been derived from the national curriculum, the impact of the new assessment regime may have an influence on the smooth and successful implementation of *Chemistry in the New Zealand Curriculum*.

The format of the chemistry curriculum followed the generic model used in all national curriculum statements that had been used previously; that is, the description of

- Achievement Aims, which set out the goals for the curriculum and provide themes that link the achievement objectives for levels 6, 7 and 8 (Forms 5-7).
- Achievement Objectives for each level that interpret the aims in more specific terms that can be demonstrated.
- Sample Learning Contexts for each level that provide examples of familiar and/or interesting settings that should help students develop their understanding.
- Possible Learning Experiences at each level that suggest a wide range of different learning activities to help guide teachers on the concepts, language, approaches, materials and equipment appropriate to that level.
- Assessment Examples which provide guidance for planning suitable assessment tasks.

How useful this particular format is to teachers planning new teaching programmes is one question this evaluation should help answer.

Research in the field of chemistry curriculum development is very limited in New Zealand. This is largely due to the fact that, until the production of *Chemistry in the New Zealand Curriculum*, no national curriculum document coordinating senior school chemistry from Forms 5 to 7 had been published. Previously examination prescriptions and teacher guides produced by the former Department of Education were used as the basis for programme design. No published evaluation could be found of these prescriptions or teacher guides. Similarly, no published evaluations of current curriculum statements could be found despite the fact that some, for example English and Mathematics, have been used in schools for over five years.

### **1.3 Teachers and Change**

Any planned curriculum change is only as good as the teachers working in a school; it is teachers who finally shape what happens with students in classrooms and how curriculum plans are interpreted. Curriculum development and change in schools occur because teachers change. So why then should teachers change? Presumably one of the prime reasons is that they perceive benefits in doing so; they will get more satisfaction, students' learning will improve and both the school management and parent community will be pleased. But what teacher characteristics are likely to contribute to or inhibit change?

Ramsay, Harold, Hwak, Kaai, Marriott, and Poskitt (1990) found that the following characteristics were linked to willingness to change:

- Openness to new ideas.
- Willingness to share ideas with colleagues and parents.
- Preparedness to take risks.

They also found that other teacher characteristics worked against change:

- Cynicism about any suggestions for change and new ideas.
- Professional 'experts' who thought they had nothing to learn.
- Insecurity about their own practices and a fear of being exposed.
- Lack of commitment to teaching.
- A conservative view that things should stay the same as always.

Teachers react to change in different ways. Some welcome it and are ready to try new approaches and ideas. Others need to be persuaded to contemplate change and then engage in it. Some resist change, being comfortable with what they already do. Resistance to change is understandable when the demands of teaching are considered. Teaching is an exceptionally busy job and most teachers have their hands full coping with the daily tasks associated with teaching the curriculum and responding to the numerous other demands of the job.

Fullan (1991) has identified four criteria that teachers use to assess any particular proposed change:

- whether or not the change addresses a perceived need and whether there is any evidence that the change works by doing what it claims to;
- the clarity of explanation about what a teacher will have to do to implement the change;
- the demands that the change will make on a teacher's time, energy and skills, and how existing priorities will be affected;
- the potential rewards of the change regarding interaction with colleagues and others.

Fullan argued that, even when an innovation is clearly described at the outset, teachers need time for clarification. It is only experience with the change that teachers will understand what is involved. 'Change is a process, not an event' (Fullan, 1991, p130), and effective change requires support and external assistance.

What form should this support and assistance take? Teacher organisations and individual teachers frequently claim that the answer lies in the provision of more in-service education which should continue throughout a teacher's career. However, on its own, more in-service education is inadequate. What is needed is more *effective* in-service education. McGee (1997, p 294) reported serious shortcomings with much in-service education in New Zealand including:

- too many one-shot in-service courses and sessions;
- a lack of follow-up activities;
- the general lack of focus of many programmes and the lack of specificity to classroom teaching behaviour;

- topics for in-service courses were often imposed upon teachers;
- the purposes of in-service courses were not often matched by the material delivered.

The nature of in-service education is changing with the move towards more school-based curriculum development where teachers interact with one another and collaboration between small cohorts of schools is encouraged. Teacher development and curriculum development must operate in tandem if change is to be effective.

In the early nineties part of an ongoing Learning in Science Project (LISP) was a three-year teacher development project which ran a series of in-service courses for teachers with the aim of changing their classroom behaviour to achieve more effective curriculum implementation. The teacher development involved helping teachers incorporate into their teaching the finding of previous parts of the LISP which focused upon children's learning in science and international literature on science learning, (Bell, 1993). From this project a model of teacher development was constructed which incorporated three connected aspects for teacher development; professional aspects, which related to classroom practice; personal aspects, which related to coping with their own views about changing themselves; and social aspects, which related to how a teacher works with other teachers and their students. Bell (1993) suggests that these three aspects lead to collaborative ways of working, the development of alternative classroom practices and a sense of empowerment over changes of teaching. A major finding of Bell's work was that it demonstrated the essential relationship between curriculum development and teacher development so that change can be effective.

#### 1.4 Research Questions

The major purpose of this study was to determine the extent to which *Chemistry in the New Zealand Curriculum* has influenced teaching approaches and learning programmes in schools and to determine the major barriers or tensions that could affect successful implementation. The research centred around the following fundamental questions.

1. What is the general level of support and understanding amongst secondary school chemistry teachers for *Chemistry in the New Zealand Curriculum* as a framework in which to develop learning programmes? In other words, how useful is the curriculum to the classroom teacher?
2. Is there any difference between the level of support of the curriculum from teachers with different backgrounds; for example, gender, age and school type?
3. What, if anything, has changed from previous teaching approaches and learning programmes? That is, has the intent or philosophy of the curriculum been incorporated into classroom practice and to what extent has the curriculum been implemented?
4. What are the major barriers or tensions that influence successful implementation of the new curriculum?

## CHAPTER 2

### METHOD OF EVALUATION

#### 2.1 Rationale

The research was divided into two stages:

- Stage 1:* A questionnaire was developed to survey a sample of secondary school chemistry teachers that reflect the balance of the nation's school types and sizes. The questionnaire was answered by teachers on an individual basis.
- Stage 2:* The major themes that emerged from the data gathered in Stage 1 were used to develop further questions that were used for in-depth interviews with practising chemistry teachers.

#### 2.2 Sample Selection

Statistics provided in the *Directory of New Zealand Schools and Tertiary Institutions* (Ministry of Education, 1997) were used to determine the proportion of different school sizes, authority (state, integrated, private), gender and region. These proportions were used to select a stratified random sample of schools that closely reflected the distribution of different schools throughout New Zealand. A sample of 144 schools was selected, representing nearly half of the secondary schools offering chemistry in their senior curriculum.

The questionnaire was sent to schools in April 1997. The initial response rate was poor; only 42 individuals responded (29.1%) and another request was made by fax to the remaining schools in June. This resulted in a further 15 responses giving a total of 57 questionnaires to analyse (39.6% of the original sample). Fortunately the 57 respondents reasonably closely mirrored the national proportions by size, region, authority and gender, as Table 1 shows.

The six teachers chosen for interview were selected on the basis of their gender, varying degrees of experience, and the type of school in which they taught. All were known by the researcher prior to interview. The variety in the backgrounds of those interviewed is illustrated in Table 2.

**Table 1**

The distribution of respondents by school size<sup>\*</sup>, region<sup>\*\*</sup>, authority and gender.

School Type		Proportion Nationally (%)	Sample Selected (%)	Sample Returned (%)
Size	< 500	42	41	37
	500-1000	40	39	45
	> 1000	18	20	18
Region	Northern	38	37	32
	Central	33	34	33
	Southern	29	29	35
Authority	State	75	75	74
	Integrated	17	15	12
	Private	8	10	14
Gender	Co-ed	70	71	60
	Boys	14	13	14
	Girls	16	16	26

**Table 2**

Backgrounds of Teachers Interviewed

Teacher	Age	Gender	Years of Chemistry teaching experience	Type and size of school(s) taught in previously	Current school
A	37	Male	14	Co-ed, >1000	Boys, >1000
B	28	Female	3	Girls, 500-1000	Co-ed, >1000
C	50	Male	28	Boys, >1000	Co-ed, >1000
D	27	Male	2	-	Boys, 500-1000
E	55	Female	33	Girls, 500-1000 Co-ed, 500-1000	Girls, 500-1000
F	56	Male	26	Boys, >1000	Co-ed, <500

\* Composite schools with less than 100 students were not selected since they are unlikely to teach senior chemistry.

\*\* Northern: Northland, Auckland, Waikato  
Central: Bay of Plenty, Poverty Bay, Hawkes Bay, Taranaki, Manawatu, Wellington  
Southern: South Island

## 2.3 Questionnaire Design

The questionnaire (Appendix 1) was developed with the support of five experienced Christchurch chemistry teachers. Several drafts were trialled and the type of information that would be most useful in assisting further curriculum development in chemistry was always considered to be vital in the refinement of the questionnaire.

The questionnaire was divided into two sections. Section one collected biographical information about the individual respondent and included gender, age, years of chemistry teaching experience, position in the school (for example, Head of Department, full-time classroom teacher), highest level of chemistry studied at university, and experience in chemistry-related careers outside teaching.

Section two was dedicated to the curriculum evaluation and sought the individuals' response to the following aspects of *Chemistry in the New Zealand Curriculum* (CINZC).

- Familiarity with the document.
- The level of agreement with the philosophy of the document.
- The usefulness of the document as a guide to planning, assessing and classroom practice.
- The usefulness of the various components of the curriculum, that is the Achievement Aims; the Achievement Objectives; the Sample Learning Contexts; the Possible Learning Experiences; the Assessment Examples and the Developing Investigative Skills and Attitudes in Chemistry.
- The extent to which the curriculum has changed the core content and subject matter traditionally taught.
- The degree of approval for the emphasis the curriculum suggests are important in teaching chemistry, that is the emphasis on practical investigation; the interaction between chemistry, people and the environment; the linking of chemical concepts and patterns of behaviour through appropriate contexts and the completion of an extended practical investigation by Level 8.
- The amount of content described at each of the levels and any important omissions or superfluous material.
- The major strengths and weaknesses of the document.
- The influence of the curriculum on teaching style.
- The level of structure and guidance the curriculum provides for programme design.
- The extent to which the general philosophy and direction suggested by the curriculum have been incorporated into the teaching programme.
- The success or otherwise of implementation in the school.
- The factors that have obstructed successful implementation of the curriculum.
- The changes needed to make the curriculum more suited to the respondents' needs.
- The general feeling about the suitability of the curriculum as the platform for chemistry teaching and learning in the senior school.



## **2.4 Interview questions**

The statistical data and emerging themes gathered in Stage 1 were used to frame a set of interview questions to be used with selected chemistry teachers (Table 2) in Christchurch schools. The interview questions were trialled with, and evaluated by, an independent group of three experienced teachers and two teacher educators, all well known by the researcher. The interviews were carried out in the interviewees' respective schools during September 1997. A copy of the interview questions can be found in Appendix 2. Each interview was recorded on audiotape and subsequently transcribed.

## **2.5 Data Analysis**

The collected data were transferred to an *Excel* database for analysis. Frequency counts were made and subsequent group proportions were calculated, tabulated and where appropriate presented graphically. The means, standard deviations and comparisons of means for "value scale" data were calculated and the results tabulated (Chapter 3).

Space was provided on the questionnaire for respondents to comment. The comments were collated for each question and common themes were identified. During the initial analysis of the comments it became apparent that there were considerable differences in the enthusiasm and support for certain aspects of the curriculum. At times these differences were quite divergent and subsequent analysis revealed that the differences were largely gender based. For this reason all comments were subsequently separated into male and female groups and analysed on this basis.



## CHAPTER 3

### RESULTS AND DISCUSSION

#### 3.1 Description of Respondents

Table 3 summarises the backgrounds of the individual respondents in terms of gender, age, years of chemistry teaching experience, position held in the school, highest level of chemistry achieved at university, and experience outside teaching in a chemistry-related career.

**Table 3**

Description of the backgrounds of the respondents

Characteristic	Group	Proportion (%)
Gender	Female	46
	Male	54
Age	21-30	9
	31-40	17
	41-50	51
	>50	23
Years of chemistry teaching experience	1-5	18
	6-10	26
	11-15	11
	>15	45
Position held in school	Part-time classroom teacher	3
	Full-time classroom teacher	18
	Position of responsibility in chemistry	35
	HOD Science	44
Highest level of chemistry achieved at University	1st year	9
	2nd year	11
	3rd year	43
	B.Sc. Hons	16
	M.Sc.	12
	Ph.D.	9
Experience in a chemistry- related career	Yes	42
	No	58

Table 3 revealed several interesting points. The proportions of female and male respondents were approximately equal. This may reflect the current gender ratio of chemistry teachers (no data are currently available to check this) but historically the proportion of female to male chemistry teachers has never been equal with a much greater proportion being male. Nearly 75% of the respondents were aged over 40 and probably reflects the current average age of secondary school teachers (43 years).

Almost 80% of the respondents held a position of responsibility in chemistry in their school. Since only one questionnaire was sent to a school and an individual response was asked for it was likely that the head of the chemistry department would complete the questionnaire. The small proportion of younger, less-experienced teachers who took part in this evaluation is, therefore, understandable.

Almost half (45%) of the respondents had more than 15 years teaching experience and more than one third (37%) had post-graduate qualifications in chemistry. A substantial proportion (42%) of the respondents had experience in a chemistry-related career outside teaching.

The sample of chemistry teachers who responded to the questionnaire was reasonably representative of the national distribution of schools by size, region, authority and gender. The largest deviations from the national proportions occurred in the school gender distribution where 11% fewer co-educational schools and 10% more girls' schools were represented. The fact that only 57 out of the original 144 questionnaires distributed (36.9%) were returned was disappointing. This could reflect a lack of interest in curriculum change or is, perhaps, an indication of the lack of time chemistry teachers have to complete questionnaires given the current demands of their job.

It was not possible to determine whether the proportions of individual teachers reflected the national population of chemistry teachers in terms of age, gender, years of experience, and qualifications since such information has not been gathered in the past. One interesting and quite surprising statistic related to the high proportion (42%) of respondents who had experience in a chemistry-related career outside teaching.

### 3.2 Other Background Data

- The respondents' class sizes varied considerably as the figures below, expressed as percentages, show:

	<u>Number of students/class size</u>		
	<10	10-20	>20
6th Form	12	39	49
7th Form	30	38	32

Those with class sizes less than 10 tended to be the smaller rural schools while those with class sizes greater than 20 tended to be the larger urban schools. This result is not unexpected.

- The majority (58%) of teachers responded that they were 'more than satisfied' with the nature of their school facilities; 22% described their facilities as satisfactory and 20% described their facilities as unsatisfactory.
- Of the respondents, 46% provided written feedback to the Ministry during the development of *Chemistry in the New Zealand Curriculum*.

The mean class size for Year 12 was around 20 and for Year 13 around 15. Class size was mentioned by only one respondent as a barrier to curriculum implementation. It should be of concern to policy-makers at both school and national level that one in five respondents described their teaching facilities as unsatisfactory.

### 3.3 Curriculum Evaluation

The following results, from section two of the questionnaire, are divided into three major groups. The first group (I) describes the summary statistics for all respondents, and is sub-divided according to the type of question asked.

The second group (II) describes the summary statistics of female and male groups where comparisons were made between the responses of those groups to selected questions.

The third group (III) describes the summary statistics of other selected biographical cohorts; namely age, school size and school gender. The purpose of comparing different cohorts was to determine if there were any significant differences between the backgrounds of the respondents and their impressions of the curriculum statement and its implementation.

## **(I) Summary statistics for all respondents**

### **(A) FAMILIARITY WITH CINZC**

In the first question respondents were asked to describe their familiarity with the curriculum document. The results are given in the following table:

<b>CATEGORY</b>	<b>% RESPONSE</b>
Read the document thoroughly	46
Read parts of the document thoroughly	40
Skim read the document	12
Not read the document at all	2

A high proportion (86%) of respondents was quite familiar with the curriculum document. One respondent claimed not to have read the document at all yet was prepared to make judgement on its contents. The validity of this respondent's information must be questioned but was, nevertheless, included.

### **(B) VALUE SCALE RESPONSES AND ASSOCIATED COMMENTS**

Table 4 summarises the means and standard deviations of answers to questions that required a value scale response. A five point scale, 5 being high or positive and 1 being low or negative, was used for each of these questions and the descriptors used for each scale are included in the table. A value of 3 was interpreted as a neutral position. The questions that required a value scale response were numbers 2-8, 16-18 and 21. Although the data gathered was ordinal it was assumed that the intervals used in the 5 point scale were approximately equal and therefore it was appropriate to calculate means and standard deviations.

**Table 4**

Statistical summary of information from 'value scale' questions

Question number and category	Mean	Standard Deviation
2. General agreement with philosophy (5 = Strongly agree 1 = Strongly disagree)	4.1	0.7
3. Usefulness for planning (5 = Very useful 1 = Not useful at all)	3.0	1.3
4. Usefulness for assessment (5 = Very useful 1 = Not useful at all)	2.8	1.2
5. Usefulness for classroom practice (5 = Very useful 1 = Not useful at all)	2.6	1.1
6. Usefulness of different curriculum components (5 = Very useful 1 = Not useful at all)		
(a) Achievement Aims	3.3	1.3
(b) Achievement Objectives	3.4	1.3
(c) Sample Learning Contexts	3.1	1.2
(d) Possible Learning Experiences	3.4	1.0
(e) Assessment Examples	3.1	1.2
(f) Developing Investigative Skills and Attitudes	3.2	1.2
7. Subject matter/content change (5 = Changed substantially 1 = Not changed at all)	2.2	1.1
8. Approval of specific emphasis (5 = Strongly approve 1 = Strongly disapprove)		
(a) Practical investigation	4.3	0.9
(b) Interaction between chemistry, people and environment	3.9	1.0
(c) Linking concepts and patterns through contexts	3.7	0.9
(d) Completion of an extended practical investigation	3.7	1.2
16. Incorporation of <i>CINZC</i> into own teaching programme (5 = Substantial attempt 1 = No attempt at all)	3.5	1.4
17. Success in implementation of <i>CINZC</i> at school (5 = Very successful 1 = Not successful at all)	3.3	1.3
18. Barriers to implementation (5 = No effect at all 1 = Critical effect)		
(a) Lack of adequate resources	3.0	1.5
(b) Lack of professional development	3.0	1.4
(c) Lack of time	1.8	1.1
(d) Lack of belief	4.0	1.4
(e) Influence of Unit Standards	3.0	1.6
21. Overall feeling ( 5 = Very positive 1 = Very negative)	4.0	0.8

### Consideration of each 'Value Scale' question in turn:

- E.2 *To what extent do you agree with the philosophy of the curriculum in terms of your own teaching?*

In general, the philosophy was accepted positively (mean = 4.1) but several comments reflected the difficulty of translating good philosophy into good practice, with the constraints of class size, the absence of useful resources, and restrictions of examination prescriptions. Women teachers' comments were generally more constructive and positive than those of their male counterparts.

For example, "I am a strong advocate of contextual and student-centred learning and I appreciate the flexibility that the document allows me in my teaching." (female)

"Too much of the philosophy is based on a constructivist's view of science and the tone of the philosophy suggests that chemical knowledge is less important than being able to carry out skills." (male)

- E.3 *How useful have you found CINZC for planning your chemistry programme?*

In general the respondents were neutral regarding the usefulness of CINZC for planning purposes. (mean = 3.0)

All females' comments were positive. One example, "particularly useful set of suggestions for teaching and the level at which to pitch learning", is typical. Males' comments tended to imply that what was currently being taught in their schools "fitted" the curriculum well and that "little change was necessary". Several respondents mentioned the 'Learning Experiences' as being a helpful source of new ideas but that the ideas needed more detail, particularly in terms of references to the resources needed for practical work.

- E.4 *How useful have you found CINZC as a guide for assessment?*

The relatively low mean (2.6) indicated that the Assessment Examples were not particularly helpful to teachers. The demands of national examinations (Years 11 and 13) were cited as the driving forces for assessment of those levels, and therefore old exam questions were stated as being the best guide to assessment. Several respondents requested more detail

for the assessment activities suggested in the curriculum. Once again, the only negative comments originated from older male teachers. For example, "The assessment examples are not helpful at all for Sixth Form Certificate".

E.5 *How useful have you found CINZC as a guide to classroom practice?*

The respondents reported that *CINZC* is not a particularly useful guide to classroom practice, (mean = 2.6) although the variety of teaching strategies suggested in the Possible Learning Experiences could be more useful if they were accompanied by guide material and backed up with in-service training.

E.6 *How useful have you found the following components of CINZC for planning, assessing and teaching your chemistry programme?*

The means for each part of this question varied between 3.1 and 3.4 suggesting only relatively moderate usefulness for these curriculum components.

E.6(a) The "Achievement Aims" were described as "helpful" by most of the females and "vague" by several males.

E.6(b) The "Achievement Objectives" were again largely criticised for their lack of specificity and differentiation between Levels 6 and 7 in particular. Only females commented about the usefulness of the Achievement Objectives in a positive way.

E.6(c) The "Sample Learning Contexts" drew little comment. Those who did comment were positive about the "good ideas" presented but that more detailed contextual examples were needed.

E.6(d) More positive comments were received about the "Possible Learning Experiences" than any other component of the curriculum. Most commented on the "good ideas" and "rich and varied diet of teaching strategies". Male effusiveness was once again far more tempered than their female colleagues. For example, "These could have been grouped according to the objectives and the content of the curriculum. As it stands they are absolutely useless". (male)

"Great ideas especially for new teachers thrust into a



school stuck in a time warp". (female)

E.6(e) While nearly all the comments were favourable, several respondents suggested the Assessment Examples should be specifically linked to the numbered Achievement Objectives and that, to be more user friendly, greater detail was required - a teacher's guide would be helpful.

E.6(f) The importance of investigative practical chemistry, particularly at Levels 7 and 8, was acknowledged by the majority of respondents. Few commented on the helpfulness or otherwise of this curriculum component.

E.7 *To what extent do you think CINZC has changed the subject matter/core content that has been traditionally taught?*

The relatively low mean shown in Table 4 indicated that the respondents thought the subject matter had been left substantially unchanged.

All comments related to the relatively unchanged nature of the common core subject matter. Most respondents appeared satisfied with the slight reduction in content at all levels.

E.8 *To what extent do you approve of the following emphases that the curriculum suggests for teaching chemistry?*

E.8(a) Strong approval (mean = 4.3) was given to the emphasis CINZC places on practical investigation. However a number of comments referred to the time-consuming nature of individual extended practical investigations and mentioned this as a problem' particularly at Bursary level (Level 8), where the prescription demands are too great to allow sufficient time for extensive individual practical work.

E.8(b) While the approval rating for the emphasis the curriculum places on the interaction between chemistry, people and the environment was marginally lower (mean = 3.9) than for practical investigations), nearly all comments were related to the importance of making chemistry relevant to the world of the student. Several respondents also made the plea for resources to help in this regard. "It is time we looked at more real world examples but actual back-up material is not readily available." Of the 20 comments made the only



two negative comments were from older males and no older males made any positive comments.

- E.8(c) The linking of chemical concepts and patterns of behaviour through appropriate contexts again elicited general approval.(mean = 3.7) A dilemma was apparent from the comments: whether to begin with a general context and develop the theory or to relate theory to reality through appropriate contexts as they are required. Several respondents commented on the time-consuming nature of preparing “contextual resource material”.
- E.8(d) While general approval was given to curriculum demand of the completion of an extended practical investigation by Form 7 (mean = 3.7), more than half the respondents mentioned the enormous time demands and workload associated with this type of practical work. The most popular level for an extended practical investigation appears to be Form 6 (Level 7) because of the continuing time demands of the Bursary prescription. Resources were again mentioned by several respondents as a problem.
- E.16 *To what extent would you describe your own attempts to incorporate the philosophy and direction given by CINZC in your own teaching programme?*

The mean of 3.5 suggested only limited success in curriculum incorporation into individual teaching programmes. The majority of respondents commented that they were attempting to incorporate the general philosophy and direction given by *CINZC* into their own teaching programmes but lack of time seemed to be a significant barrier to complete success. Those who had made no attempt to incorporate the philosophy and direction suggested by *CINZC* (six respondents) were all experienced male teachers over 40 years of age. These respondents also reported no success in implementing *CINZC* at their schools. Five out of six of these schools had more than one person in their chemistry department.

- E.17 *How successful have you been in implementing CINZC at your school?*

Success in implementing the new curriculum was variable(mean = 3.3). Most teachers reported that the process was under way but the time needed to do the job properly had not yet been found. A plea for a generalised master scheme that could be adapted by individual schools was made by several respondents.

- E 18 *To what extent have the following factors affected implementation in your school? (resources, professional development opportunities, time, belief, Unit Standards)*

The mean scores listed for this question show that some elements are proving more critical barriers than others regarding successful curriculum implementation. Lack of belief was not a major barrier(mean = 4.0) while lack of time was(mean = 1.8). Lack of adequate resources, lack of professional development opportunities, and the influence of Unit Standards were reported as moderately critical.

- E.18(a) Of the twenty teachers who chose to comment about the lack of sufficient resources to support implementation, 75% specifically mentioned the lack of a comprehensive teacher guide as a critical issue. Most schools appeared to have adequate equipment for the practical work suggested in *CINZC*.
- E.18(b) While the lack of professional development opportunities were not perceived to have a critical effect in obstructing successful implementation, they were important. No national professional development programmes in chemistry have been initiated and the regional in-service programmes are "too few and far between for professional collaboration". Unit Standard training in chemistry was considered to be the most urgent need for teachers at the time of data gathering.
- E.18(c) The influence of teacher workload was an obvious barrier to successful curriculum change. Lack of time was the most critical element in preventing teachers translating a curriculum statement into a revised classroom teaching programme.

Most respondents agreed that time was essential for developing a worthwhile scheme and that time is clearly unavailable in schools at present.

E.18(d) A lack of belief in the overall direction and philosophy of the curriculum had little effect in obstructing implementation. Very few of those surveyed provided written comment (<10%) and the only negative comment came from one respondent who claimed that he “had doubts accepting the philosophy of a curriculum in which constructivists have had a major input”.

E.18(e) Over 40% of the respondents stated that Unit Standards were having a serious effect on implementation, largely because of the dual assessment problems at Form 6 where Sixth Form Certificate still exists. The majority of written comments indicated that the level of uncertainty that exists with Unit Standard assessment was unhelpful in curriculum development. Again, a marked gender difference was apparent with males being far more opposed to Unit Standards as a means of assessment.

E 21 *Overall, what is your feeling about CINZC being the platform for teaching and learning in the senior school?*

Of all respondents, 80% were either positive or very positive in their feelings about CINZC.

Only eight comments were written of which all were favourable; “a move in the right direction” seemed to best sum them up.

When the frequency data on which Table 4 was based was analysed alongside the comments the following points emerged:

- A large proportion (87%) of respondents agree or strongly agree with the philosophy of CINZC
- CINZC was perceived to be more useful for planning a chemistry programme than as a guide to assessment or classroom practice.
- The Achievement Objectives and the Possible Learning Experiences were the most useful components of the curriculum for planning, assessing and teaching a chemistry programme of learning.
- A large proportion (87%) of respondents believe that the core content or subject matter taught has largely been unaltered in the new curriculum



- The specific emphasis the curriculum places on practical investigation, the interaction between chemistry, people and the environment, the use of contexts for linking concepts and patterns and the completion of an extended practical investigation all met with general approval. Most disapproval was given to the completion of an extended practical investigation but this still only represented 12% of all respondents.
- The majority (62%) of respondents had attempted, to a certain extent at least, to incorporate the philosophy and direction indicated by the curriculum. Only 11% of respondents had made no attempt at all.
- The most important barrier to implementation was lack of time, 53% of respondents indicating that this had a critical effect for them.
- Overall, 80% of respondents had a positive feeling about *CINZC* being the platform for chemistry teaching and learning in the senior school.

Two years after publication almost half (46%) of the respondents claimed to have read *CINZC* thoroughly. Since the curriculum is supposedly the cornerstone for school chemistry schemes and teaching programmes, this figure gives evidence for the limited success schools had in implementing *CINZC*.

Despite the fact that 87% of the respondents agreed with the philosophy expressed at the beginning of *CINZC*, relatively low mean scores were recorded for questions relating to the usefulness of the curriculum for planning, assessing and teaching a chemistry programme. The mean scores for the usefulness of the various curriculum components (that is, the Achievement Aims, Achievement Objectives, Sample Learning Contexts, Possible Learning Experiences, Assessment Examples and Investigative skills and Attitudes) were marginally higher than the mean scores for the overall usefulness but still indicated a relatively neutral position. When the means for all questions relating to the usefulness of the curriculum were themselves averaged, a score of 3.1 suggested that, overall, the format and content of *CINZC* is of only limited assistance to teachers.

Stronger approval was given to the specific emphasis the curriculum places on practical work and the interaction between chemistry, people and the environment. Teaching chemistry by linking concepts and patterns through appropriate contexts received only moderate approval (mean = 3.7) as did the dictum that an extended practical investigation must be completed by the end of Year 13 (mean = 3.7).

Although the majority of respondents (62%) reported that they had attempted to incorporate the general philosophy and direction indicated by *CINZC* a small group (11%) had made no attempt to do so. Consideration of their comments suggests that this group is unlikely to do so in the future. This group comprised six males, all aged over forty, with more than 15 years teaching experience.

In general, the most negative comments originated from the older male domain.

(C) CONTENT DESCRIBED IN *CINZC*

Table 5 summarises responses regarding the amount of content described in the curriculum at each of the three achievement levels: Level 6 (Form 5), Level 7 (Form 6), Level 8 (Form 7).

**Table 5**

Summary of amount of content described at each  
Achievement Level (Percentage response)

Achievement Level	Too Much	About Right	Too Little
6 (Form 5)	19	71	10
7 (Form 6)	7	88	5
8 (Form 7)	17	81	2

The table indicates that the large majority of respondents believed that the amount of content or subject material described at each Achievement Level was 'about right' while approximately 17-19% believed 'too much' content remained at Form 5 and Form 7 where national examinations occur. At the time of data gathering no changes had been made to the national examination prescriptions to match the minor content changes written in the curriculum.

Comments relating to the content areas that should have been included or excluded at each Level revealed little commonality. The interpretation of the actual content described in the curriculum was also variable. Details that some respondents mentioned should be in the curriculum could easily be interpreted as being there anyhow; for example preparation and properties of common compounds at Level 6, fuels and fertilisers at Level 7, gravimetric and colorimetric analysis at Level 8. There were very few specific examples of subject matter that is included but should not be. Such examples were stated by individuals only and no patterns emerged. The relatively few comments received (less than 20% of respondents commented) indicated reasonable satisfaction with the content described in the curriculum.

(D) INFLUENCE ON TEACHING METHODS

The influences primarily responsible for determining individual teaching methods and style showed considerable differences between Forms 6 and 7.

Figure 1 shows clear differences between the two year levels.

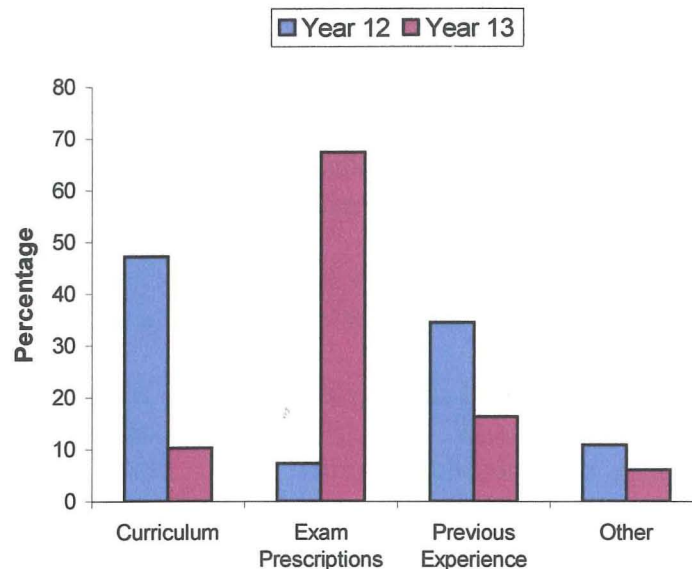


FIGURE 1: Determinant of teaching style in Year 12 (Form 6) and Year 13 (Form 7)

The Bursary prescription determined the teaching style in Year 13 for nearly 70% of respondents while the most important influence on teaching style at Year 12 was the curriculum(47%) and to a lesser extent, previous experience(38%). Although a national course is prescribed in Year 12, the absence of a national examination allows for more flexibility in teaching and three respondents noted this.

(E) AMOUNT OF GUIDANCE

Respondents were asked if they would prefer more, less or the same amount of guidance. The large majority of respondents (68%) indicated they would prefer the same amount of structure and guidance, 28% indicated they would prefer more and 4% indicated less. A reasonable degree of satisfaction was indicated with this aspect of the curriculum.

(F) STRENGTHS AND WEAKNESSES OF CINZC

Specific comments on the major strengths and weaknesses are listed in Appendix 3.



Strengths and weaknesses were subsequently sorted into female and male groups since the responses to previous questions had indicated significant gender differences.

The following strengths were mentioned by at least three respondents:

- the focus on practical chemistry and student investigation;
- the focus on relevant, meaningful learning experiences;
- the focus on linking chemistry to people and society;
- the variety of different teaching strategies suggested;
- the flexibility provided for the design of teaching programme, especially at Form 6;
- the clearer definition of content compared to the science curriculum;
- the clear layout and indication of standards required to reach the appropriate Achievement Level.

In terms of strengths, there was little, if any, difference between male and female responses, although females made more references to the linking of chemistry to practical work and society in general.

It is important to note that almost half of the respondents found no major weaknesses in the document but the following were mentioned by at least three respondents:

- the vagueness and generality of the document (“not enough detail”);
- the lack of resources available to match some of the suggested learning experiences;
- the inclusion of an extended practical investigation will be too time consuming to “cover” the suggested content adequately;
- no guidance is given about the timing of topics;
- the ‘contextual’ approach makes it hard to cover the core content;
- the lack of guidance for beginning teachers.

Overall, the major strengths of *CINZC* were perceived to be the focus on practical work, the variety of teaching strategies suggested in the Possible Learning Experiences, and the clear definition of content at each Achievement Level. The most common weakness, identified by less than 5% of the total respondents, related to the lack of detail the curriculum provided. This detail included resources for suggested practical work, timing of topics, assessment exemplars, and ‘model’ teaching sequences that use a contextual approach. When the comments on the curriculum weaknesses were analysed

alongside the comments regarding the changes required to make *CINZC* more suited to teachers' needs, it became transparently clear that a teacher's guide would enhance implementation considerably.

The most negative comments originated from the male domain. Investigation of the background of these respondents revealed that they were older (>50), had been teaching chemistry for more than 10 years and generally came from boys' schools. Perhaps the most negative comment came from an experienced male: "*CINZC* appears to want chemistry to become a conglomeration of skills loosely attached to knowledge but implying that knowledge is of little value".

(G) CHANGES REQUIRED TO MAKE *CINZC* MORE SUITED TO TEACHERS' NEEDS

Very little comment was offered other than the request for more detail regarding the assessment examples and materials and instruction required by teachers for the diverse learning experiences. Three respondents suggested the provision of an associated teacher's guide to the curriculum statement.



#### (H) BARRIERS TO SUCCESSFUL IMPLEMENTATION OF *CINZC*

Figure 3 illustrates the extent to which certain factors have affected the successful implementation of *CINZC* into schools.

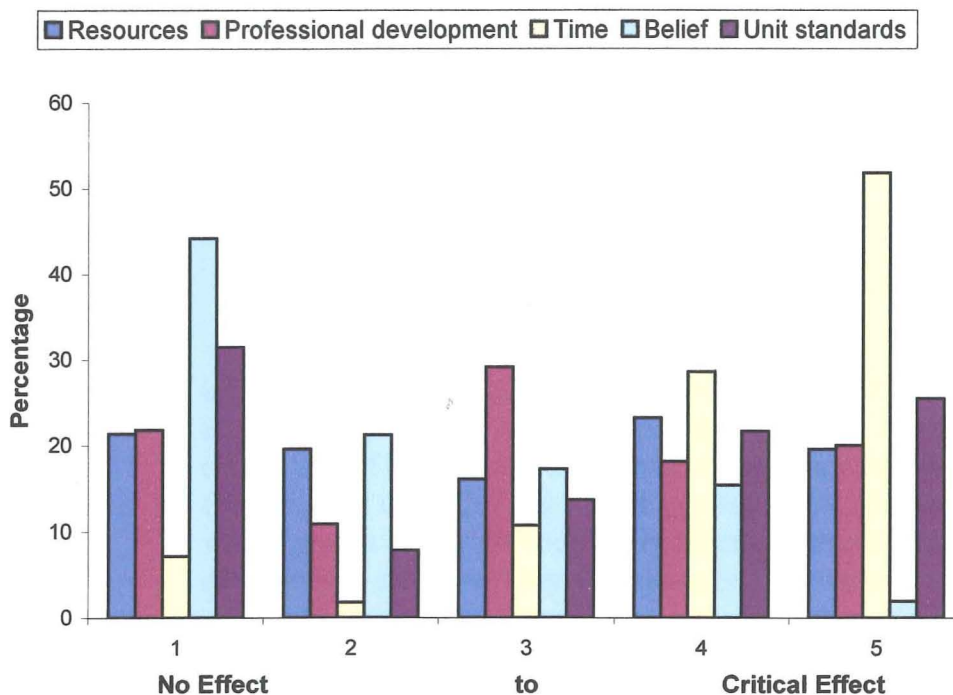


FIGURE 2: Barriers to implementation of *CINZC*

Lack of time was clearly the most critical impediment to successful implementation. A lack of belief in the direction the curriculum was not a critical barrier to implementation while the influence of Unit Standard assessment had a mixed response where 31% indicated no effect at all while 25% indicated a critical effect. Unfortunately the data did not reveal which schools were assessing by Unit Standards and it was likely that those respondents who indicated that Unit Standard assessment was not a barrier to curriculum implementation were not trialling that method of assessment. Professional development opportunities and the availability of suitable resources were not seen to be as critical to successful implementation. Nevertheless, they were not unimportant factors when over 40% of respondents described them as being critical ie a rating of 4 or 5 on the value scale.

The positive feeling about *CINZC* being the platform for teaching and learning chemistry (80% reported being 'very positive' or 'positive') was encouraging but the barriers to

implementation, especially time constraints, had resulted in limited change in many schools. Several respondents commented on the lack of professional development opportunities following the release of *CINZC*. They sought a collaborative approach where groups of schools could work together planning new departmental schemes. They also appeared to be waiting for some other person or organisation to take the initiative.

Unlike the support provided for other curriculum statements, no teacher-development programmes had been provided nationally and few in-service opportunities had been offered at the local level

## ***(II) Summary statistics for female and male groups***

Analysis of the comments made by all respondents suggested there could be significant gender differences in the level of support and enthusiasm for the curriculum statement. These differences were tested statistically using the 't' test, assuming equal variances in the male and female groups. Table 6 summarises the differences in the mean values for male and female respondents and the significance of the difference between the means for questions that required a value scale response. For questions that resulted in a significant difference between means, graphs were produced to provide further detail on the extent of these differences.

**Table 6**

### **Biographical Gender Differences**

Category	Female (%)	Male (%)
Age Group		
(a) 21 - 30	15	3
(b) 31 - 40	12	23
(c) 41 - 50	58	48
(d) >50	15	26
Years of Teaching Experience		
(a) 1 - 5	27	7
(b) 6 - 10	15	10
(c) 10 - 15	35	20
(d) > 15	23	63
Highest Level of Chemistry Studied		
(a) 1st	15	4
(b) 2nd	19	4
(c) 3rd	35	50
(d) Honours	8	21
(e) Masters	11	14
(f) Ph.D.	11	7
Type of school		
(a) Girls	93	7
(b) Boys	13	87
(c) Co-educational	36	64
(d) State	49	51
(e) Integrated	57	43
(e) Private	25	75

In terms of age, the proportions of males and females over 40 were very similar (73% female, 74% male). Although there was a higher proportion of females in the 21 – 30 age group, the proportions of males and females under 40 was also very similar (27% female, 26% male).

In terms of years of teaching experience, there was a notable gender difference. Only 17% of males had less than 10 years' experience compared with 42% of females. For those respondents with over 15 years of teaching experience, there were almost three times as many males as females.

In terms of qualifications, 34% of females had first or second year university chemistry as their highest level studied compared with 8% of males. At post-graduate level (Honours, Masters or Ph.D.) there were slightly more males (42%) than females (30%).

In summary, males tended to be more experienced and more highly qualified in terms of university study than females.

Table 7

Statistical comparison of male and female responses from value scales

Question/Category	$\bar{x}_f$ (Female)	$\bar{x}_m$ (Male)	$\bar{x}_f - \bar{x}_m$	Signi -canc
2. General agreement with philosophy	4.5	3.8	0.7	**
3. Usefulness for planning	3.6	2.5	1.1	**
4. Usefulness for assessment	3.3	2.3	1.0	**
5. Usefulness for classroom practice	3.0	2.3	0.7	*
6. Usefulness of different curriculum components				
(a) Achievement Aims	3.9	2.7	1.2	**
(b) Achievement Objectives	4.0	2.8	1.2	**
(c) Sample Learning Contexts	3.3	2.8	0.5	ns
(d) Possible Learning Experiences	3.5	3.3	0.2	ns
(e) Assessment Examples	3.4	2.8	0.6	*
(f) Developing Investigative Skills and Attitudes	3.6	2.8	0.8	*
7. Subject matter/content change	2.4	2.1	0.3	ns
8. Approval of specific emphasis				
(a) Practical investigation	4.3	4.3	0.1	ns
(b) Interaction between chemistry/people/environment	4.2	3.6	0.6	*
(c) Linking concepts and patterns through contexts	3.7	3.7	0	ns
(d) Completion of an extended practical investigation	3.8	3.8	0	ns
16. Incorporation of <i>CINZC</i> into teaching programme	4.2	2.7	1.5	**
17. Success in implementation of <i>CINZC</i> at school	4.0	2.7	1.3	**
18. Barriers to implementation				
(a) Lack of adequate resources	3.1	2.9	0.2	ns
(b) Lack of professional development	3.1	2.7	0.4	ns
(c) Lack of time	2.0	1.7	0.3	ns
(d) Lack of belief	4.0	3.8	0.2	ns
(e) Influence of Unit Standards	3.0	3.0	0	ns
21. Overall feeling	4.2	3.7	0.5	*

Probability levels: \*  $p < 0.05$ , \*\*  $p < 0.01$ , \*\*\*  $p < 0.001$ ,  
 ns = not significant at  $p = 0.05$  level.

Table 6 identifies 12 value scale responses in which male and female groups generate statistically significant differences. These differences were notably larger for certain questions. For example, questions involving philosophical agreement, curriculum usefulness, and success in implementation revealed substantial differences.

Other questions relating to barriers to implementation and approval of the specific emphases the curriculum provides showed no significantly different responses between males and females.

The following graphs further illustrate the differences between male and female groups where significantly different 'value scale' means were

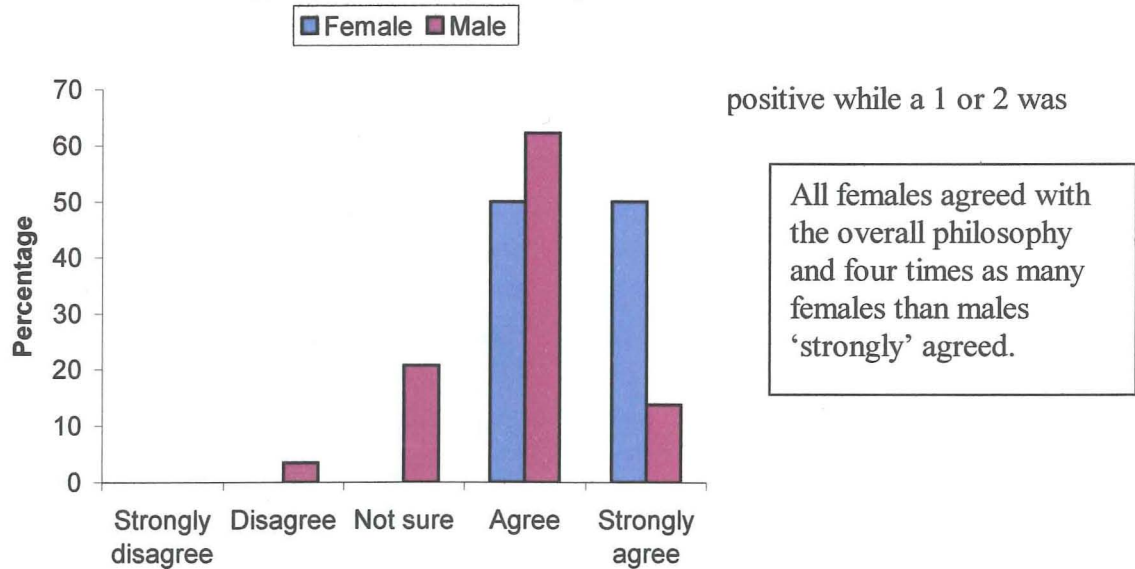


FIGURE 3: General agreement with overall philosophy of CINZC

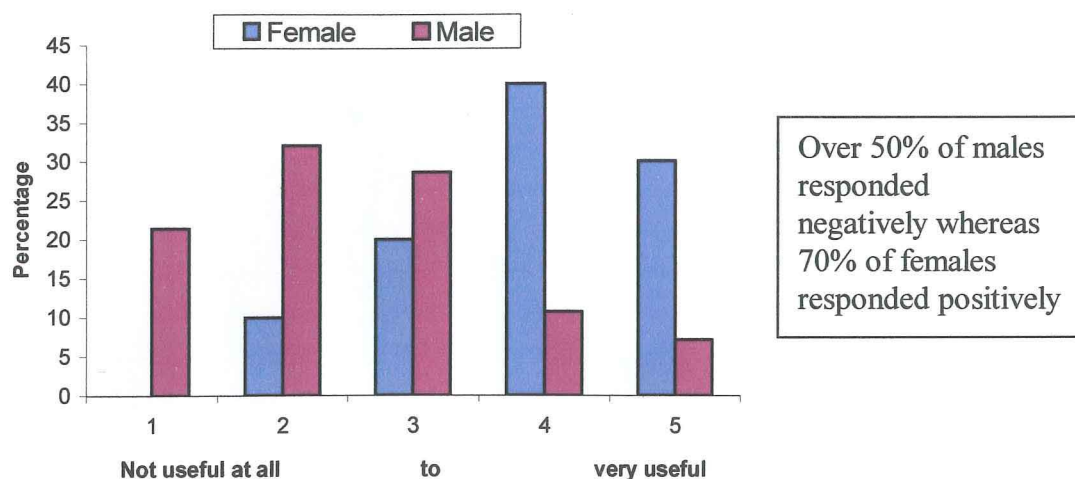


FIGURE 4: *CINZC*'s usefulness for planning a chemistry programme

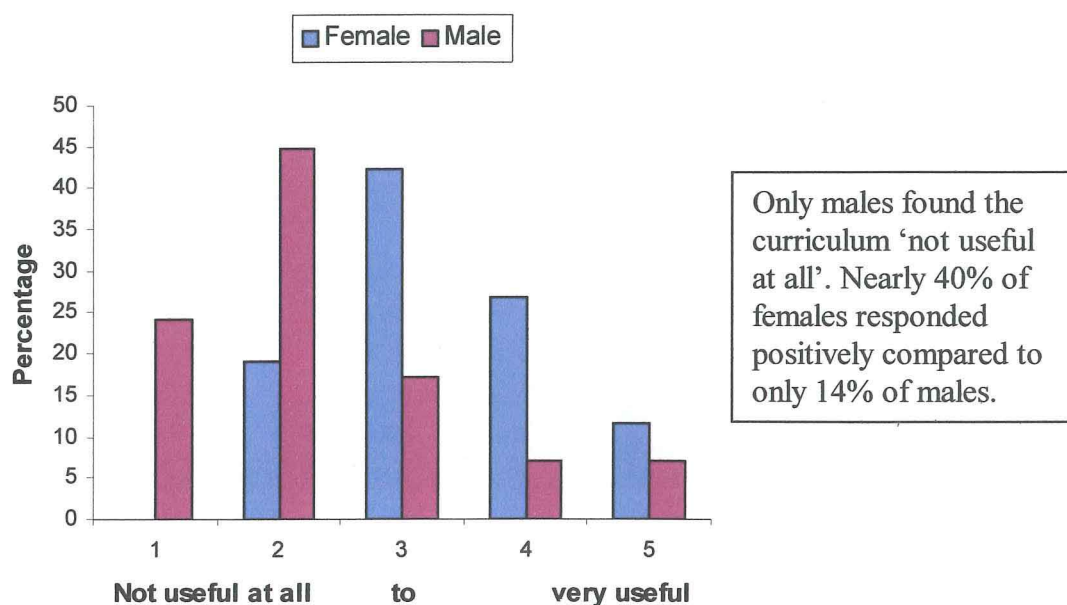


FIGURE 5: *CINZC*'s usefulness for assessing a chemistry programme



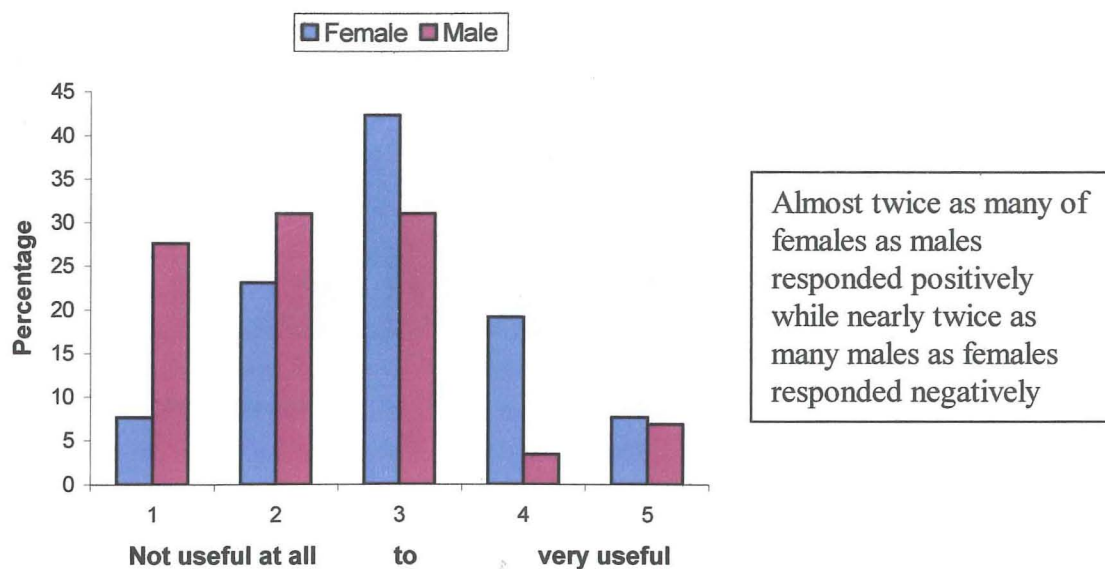


FIGURE 6: *CINZC*'s usefulness as a guide to classroom practice

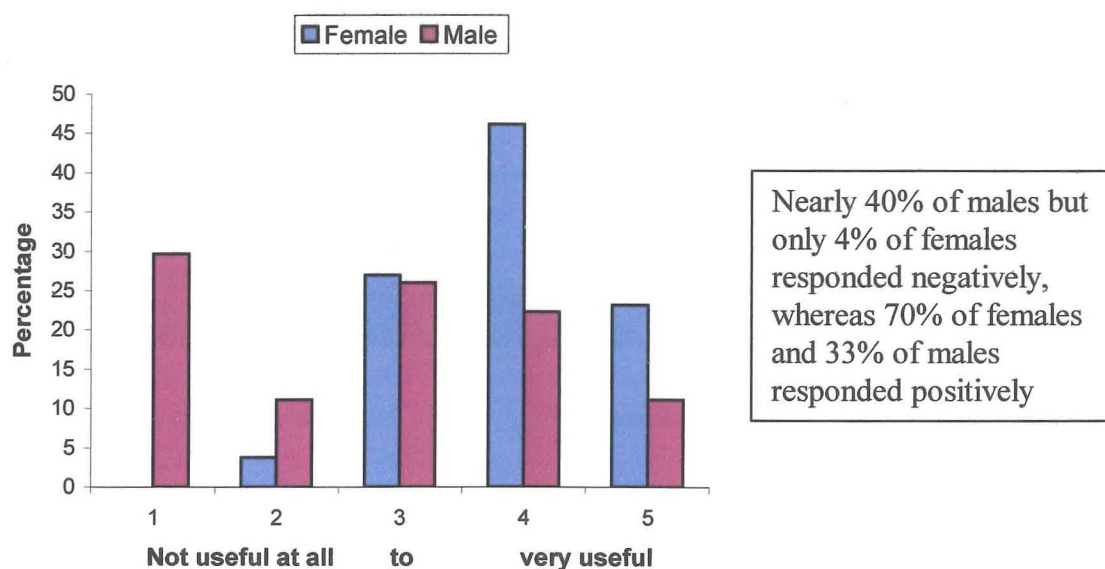


FIGURE 7: Usefulness of *CINZC*'s Achievement Aims for planning, assessing and teaching a chemistry programme

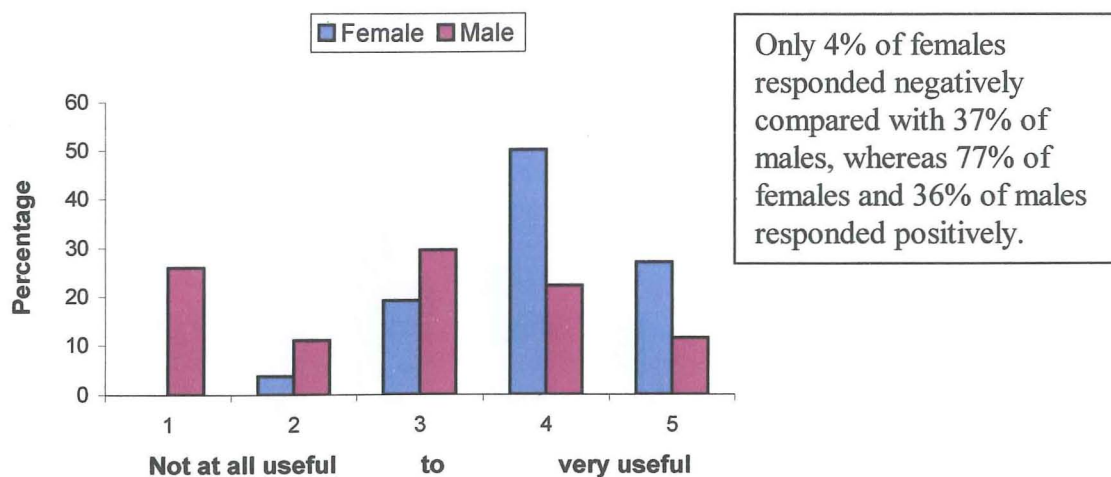


FIGURE 8: Usefulness of *CINZC*'s Achievement Objectives for planning, assessing and teaching a chemistry programme

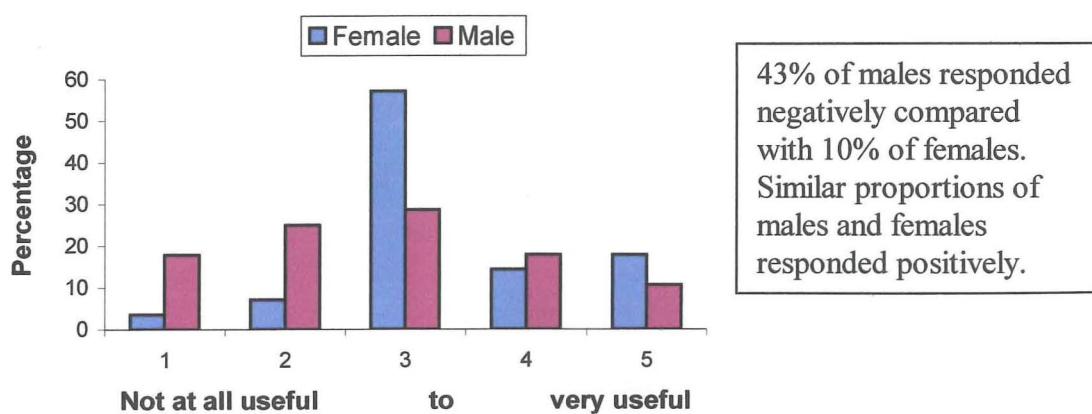


FIGURE 9: Usefulness of *CINZC*'s Assessment Examples for planning, assessing and teaching a chemistry programme.

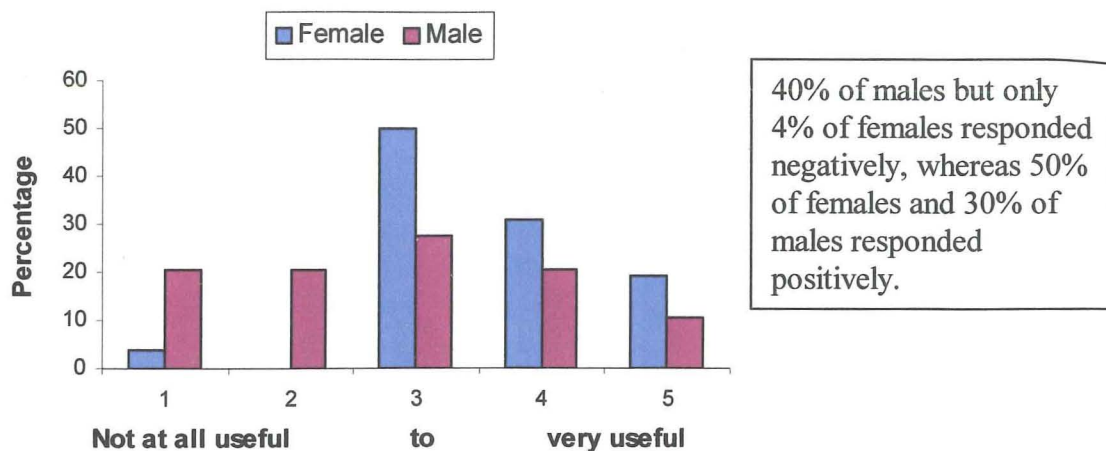


FIGURE 10: Usefulness of *CINZC*'s Developing Investigative Skills and Attitudes for planning, assessing and teaching a chemistry programme.

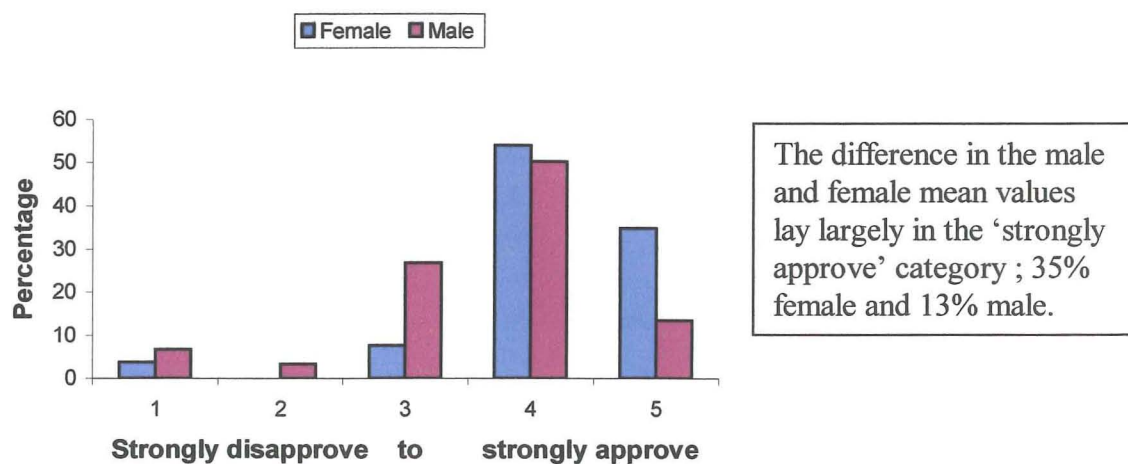
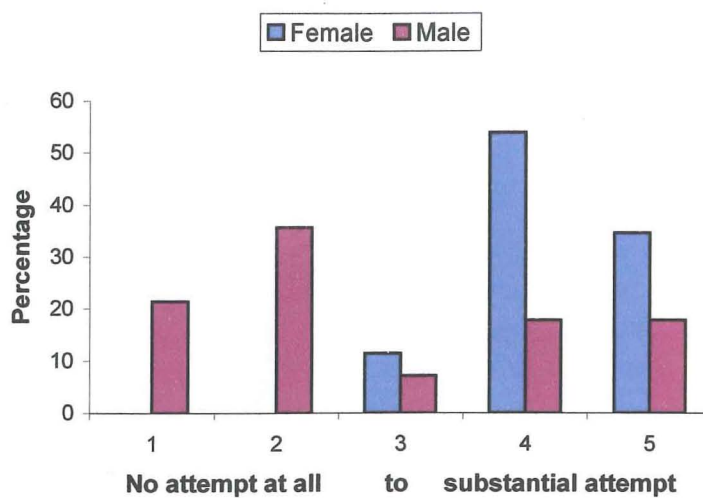
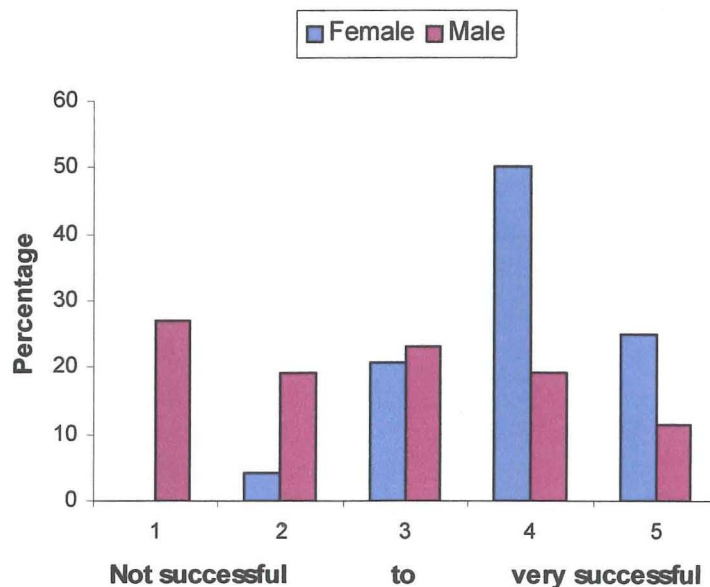


FIGURE 11: Approval of *CINZC*'s specific emphasis on the interaction between chemistry and people and the environment



This question generated the most significant differences between mean male and female responses. No females but over half (58%) of the males responded negatively. 89% of females and 36% of males responded positively.

FIGURE 12: Attempt to incorporate the philosophy and direction given by *CINZC* into the respondent's teaching programme



Again almost half (47%) of the males responded negatively. 75% of females and 30% of males responded positively

FIGURE 13: Success in implementing *CINZC* at the respondent's school.

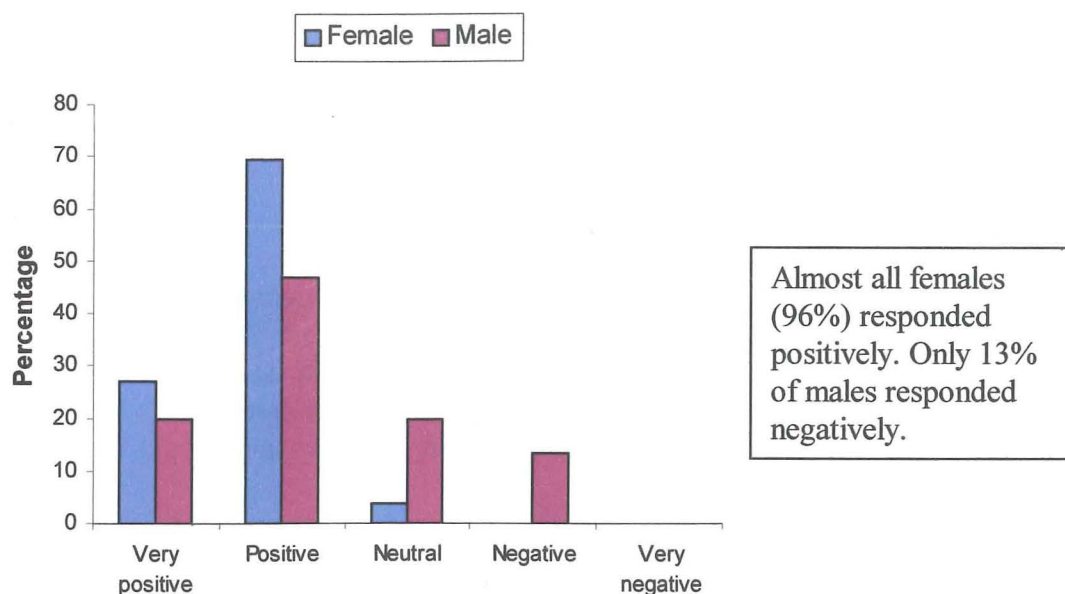


FIGURE 14: Overall feeling about *CINZC* as the platform for chemistry teaching and learning in the senior school.

No gender differences were evident when comparing the influences primarily responsible for teaching methods or style at Year 13 where the Bursary prescription dominated.

At Year 12 a different picture resulted as Figure 15 illustrates.

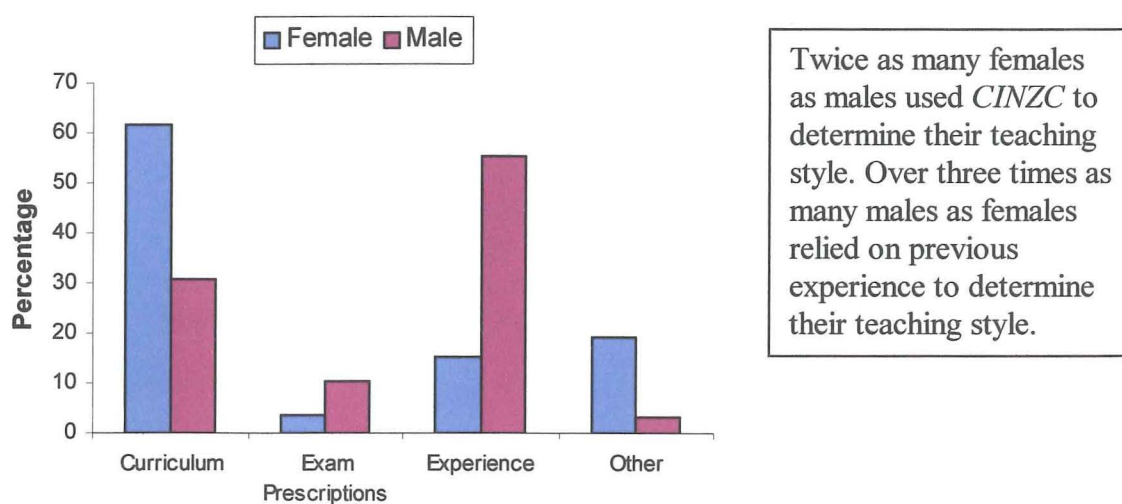


FIGURE 15: Primary determinant of teaching style in a Year 12 chemistry programme.

In summary, females were in stronger philosophical agreement with the general direction of *CINZC*. They also found the curriculum more useful for planning, assessing and teaching purposes. Over 25% of the males reported that *CINZC* was 'not useful at all' with regard to planning, assessing, and teaching.

The most significant gender differences were evident in questions relating to change. Over half of the males reported little or no attempt to incorporate the philosophy and direction given by *CINZC* into their own teaching programme whereas the great majority (89%) of females had made a considerable attempt. In terms of success in implementing *CINZC* in the respondent's school, the same pattern emerged. Nearly half the males reported little or no success compared to only one female, whereas 75% of the females and only 30% of the males reported success. This difference in willingness or capacity to change was further illustrated when the primary determinant of teaching style at Year 12 was analysed. Nearly 60% of males used previous experience to determine their approach whereas over 60% of females used *CINZC*.

### ***(III) Summary statistics for other groups***

The groups chosen for comparison were age, school gender and school size. Few differences were found when statistical analysis was carried out on responses from different regional (northern, central and southern) and school authority (state, integrated and private) divisions. Differences in responses within age groups, school genders and school sizes were less obvious than the corresponding teacher gender differences and only three 'global' questions were used to illustrate this. The questions chosen relate to agreement with overall philosophy, success in implementation, and overall feeling about *CINZC* being the platform for teaching and learning chemistry in the senior school.



## 1. Age Group Differences

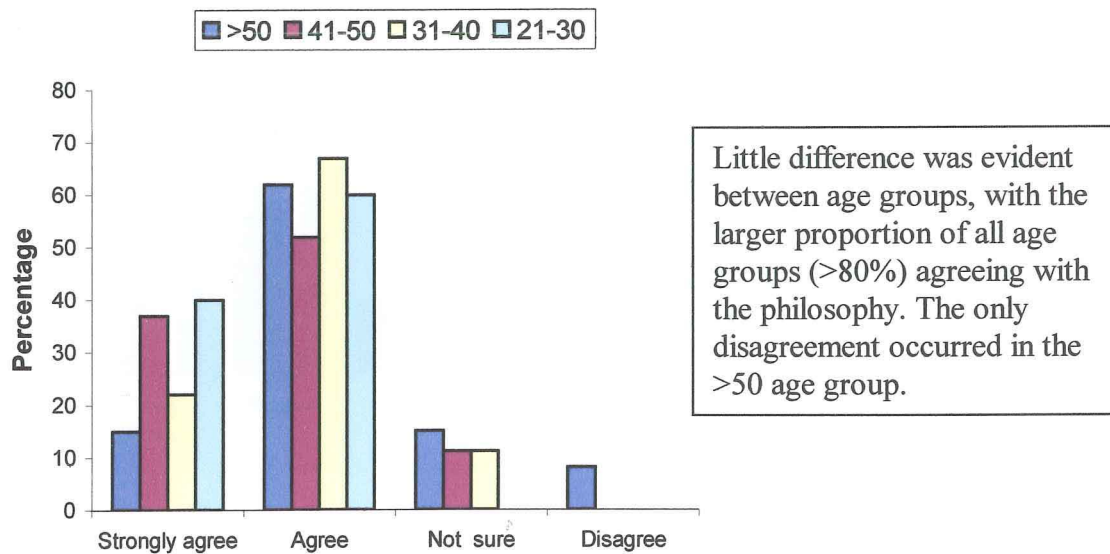


FIGURE 16: Agreement with *CINZC* philosophy

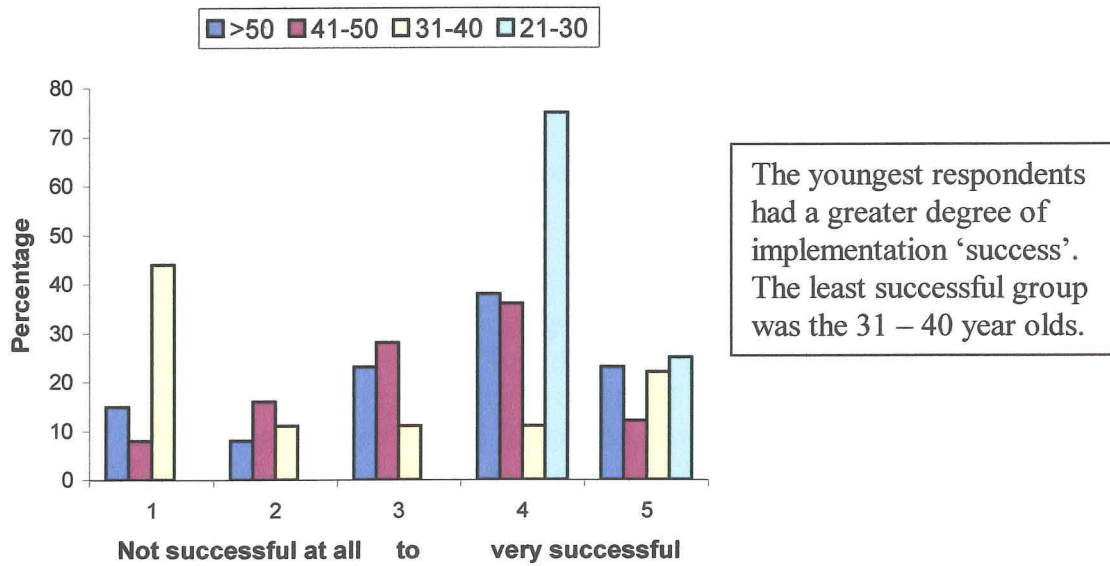


FIGURE 17: Degree of success in implementing *CINZC*



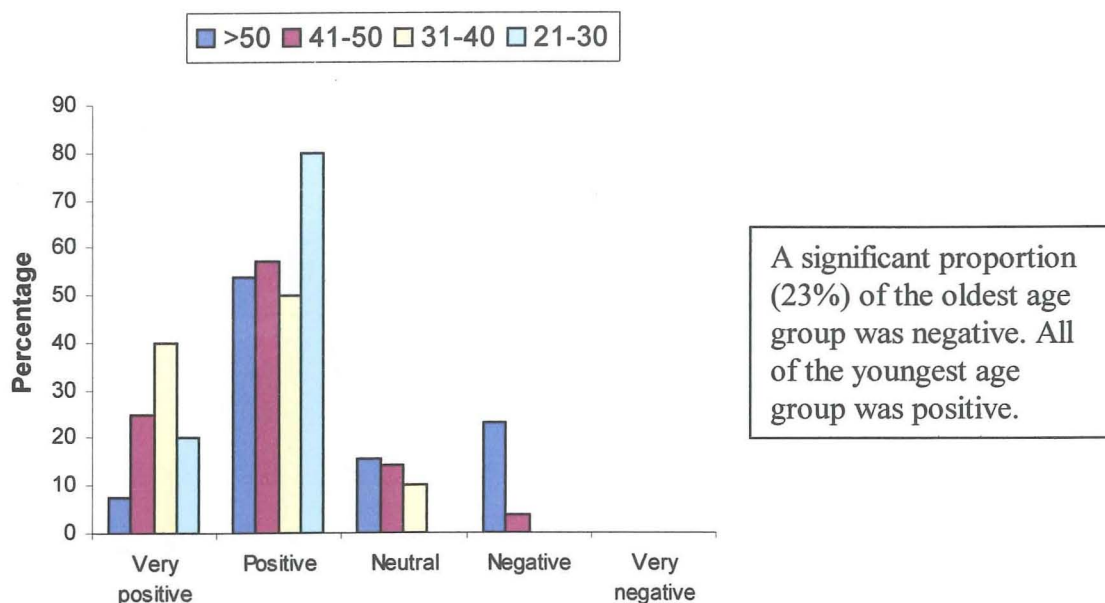


FIGURE 18: Overall feeling about *CINZC* being the platform for chemistry teaching in the senior school.

In summary, there were no major differences in the overall agreement with *CINZC* philosophy amongst the four age groups. The only negative responses came from the oldest age group. The youngest respondents reported a greater degree of 'implementation success'. The oldest age group returned the highest proportion (25%) of negative responses in terms of the feeling about *CINZC* being the platform for chemistry teaching in the senior school.

## 2. School Gender Differences

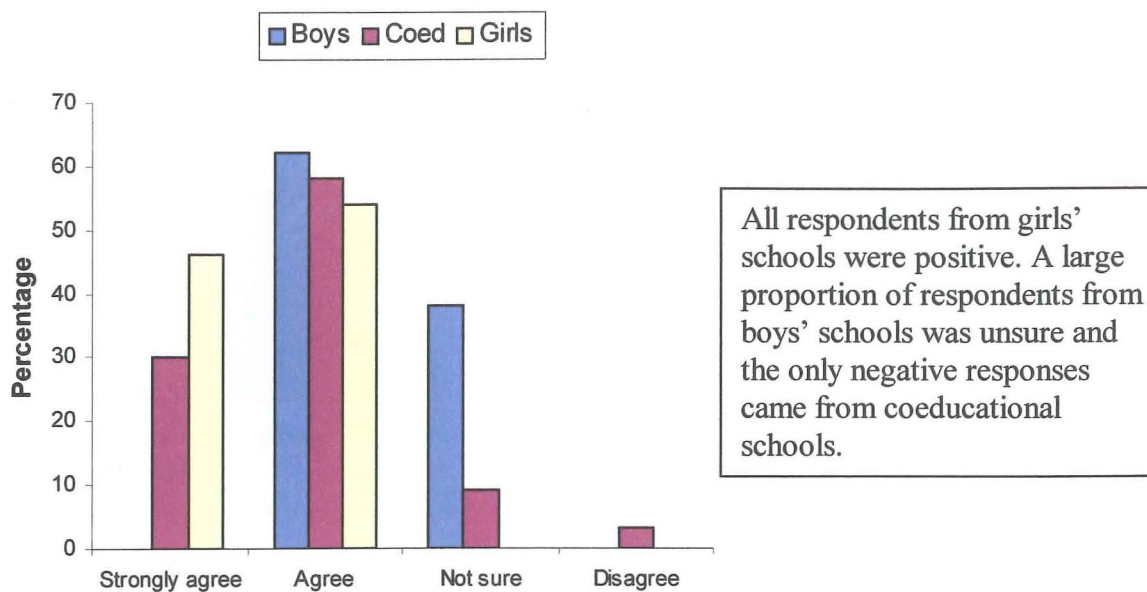


FIGURE 19: Agreement with *CINZC* philosophy

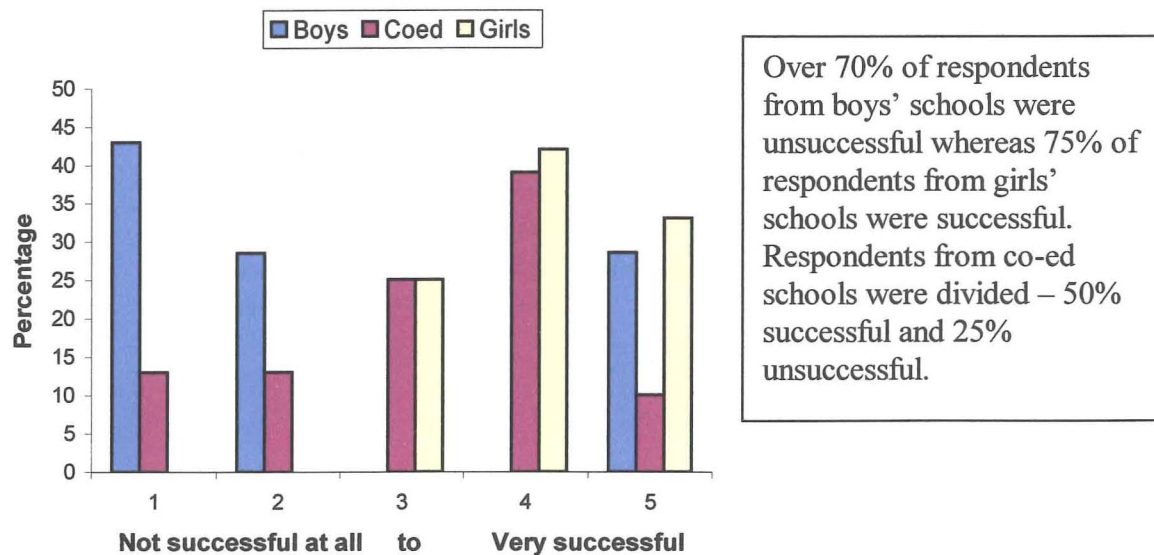


FIGURE 20: Degree of success in implementing *CINZC*

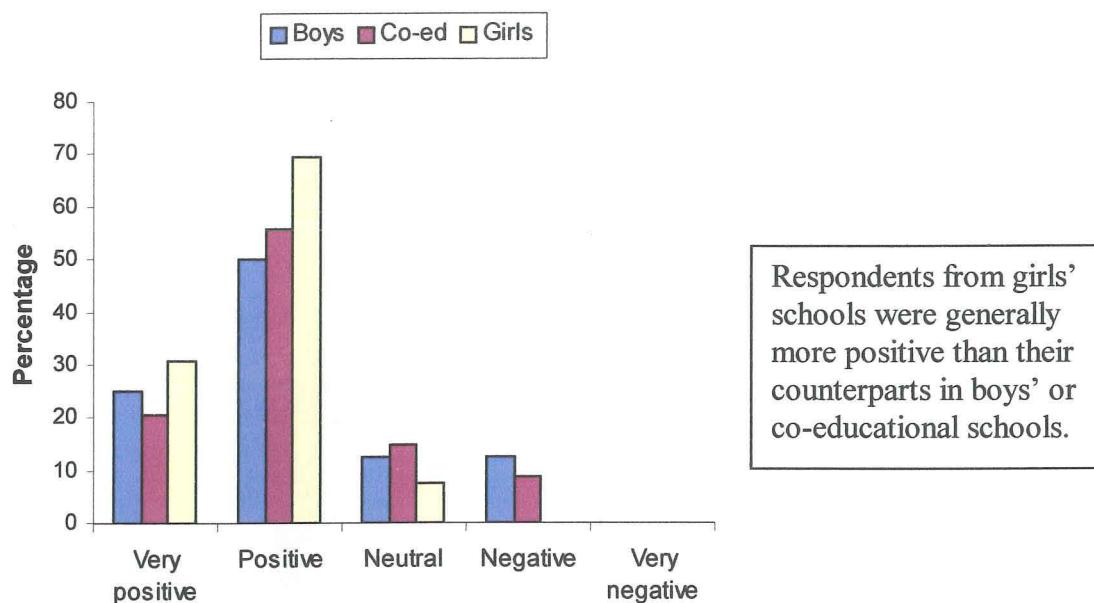


FIGURE 21: Overall feeling about *CINZC* being the platform for chemistry teaching in the senior school.

In summary, respondents from girls' schools were more positive than their counterparts in co-educational and boys' schools. This result is strongly correlated to gender trends since all but one of the respondents from girls' schools were female (see Table 5). The most significant difference was evident in the degree of success in implementing *CINZC*; over 70% of respondents from boys' schools were unsuccessful whereas 75% of respondents from girls' schools were successful. Co-educational schools were less successful than girls' schools but more successful than boys' schools.

### 3. School Size Differences

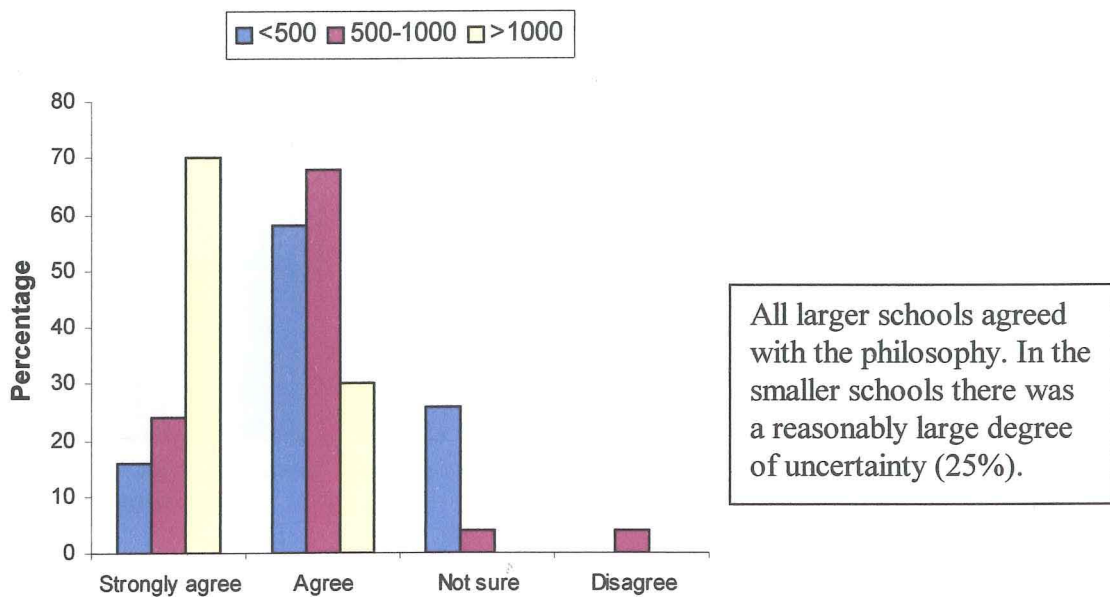


FIGURE 22: Agreement with *CINZC* philosophy

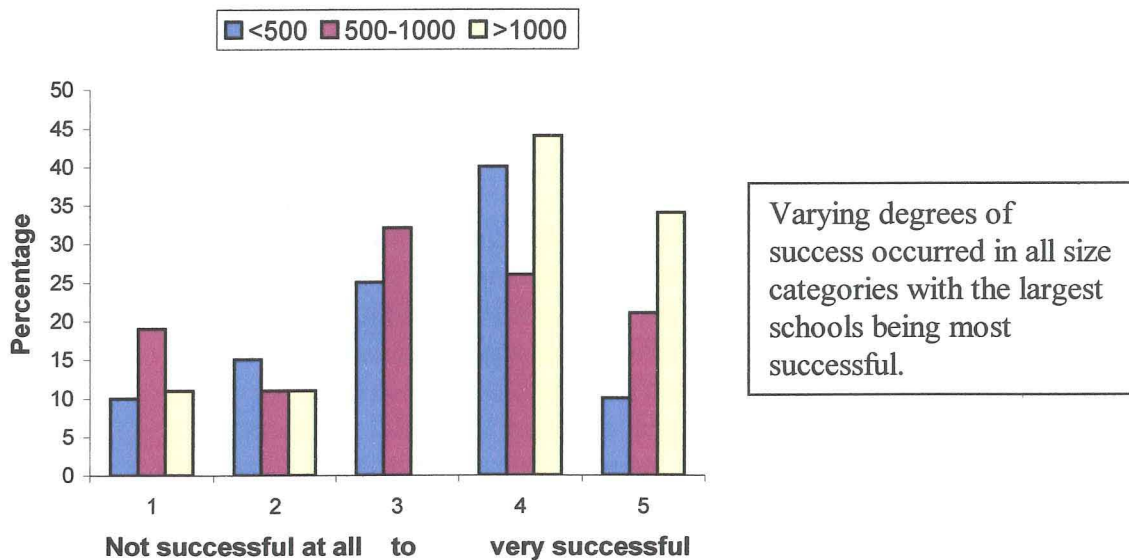


FIGURE 23: Degree of success in implementing *CINZC*

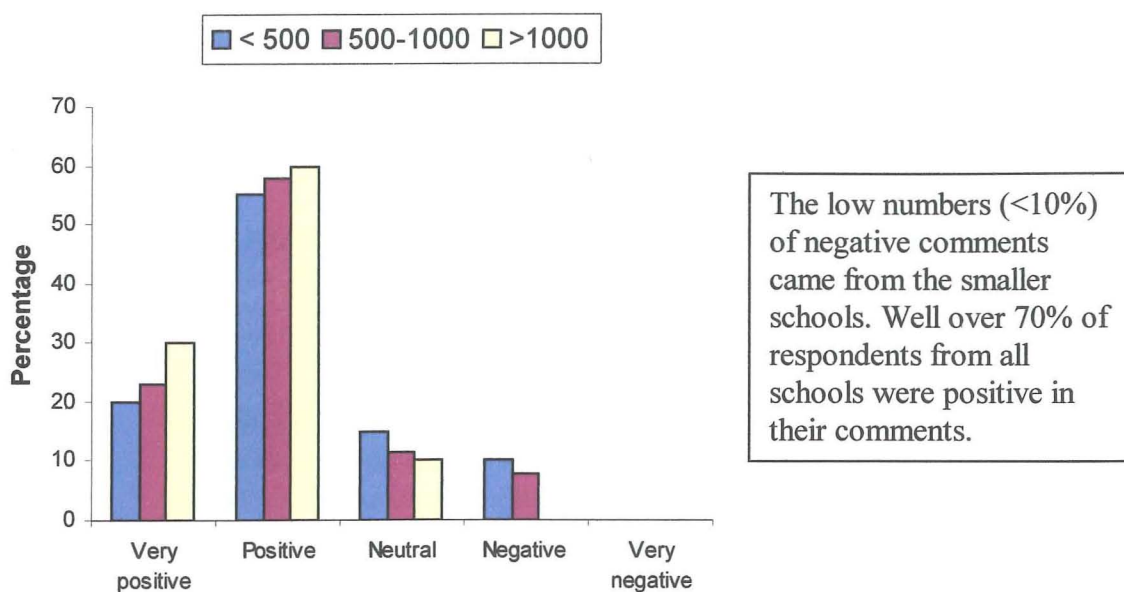


FIGURE 24: Overall feeling about *CINZC* being the platform for chemistry teaching in the senior school.

In summary, the only disagreement with *CINZC* philosophy came from two respondents in smaller schools (<500). Strongest agreement came from the larger schools (>1000). It is reasonable to assume that larger schools have chemistry departments with more than one teacher, greater resources, more collegial support and therefore more likely to succeed in implementing *CINZC*. The results support this view. The small proportion of negative 'overall feelings' was also from the smaller schools.

### 3.4 Interview Summaries and Emerging Themes

The following summaries have been constructed from the transcripts of the taped interviews of the teachers described in Table 2.

*Question 1* When you start your sixth form course, what topic(s) do you begin with and why do you begin there? How has this changed, if at all, over time?

Experience had an obvious influence on the responses to this question. The younger, less-experienced teachers both began from a theoretical perspective (structure/bonding and quantitative chemistry), whereas the more experienced practitioners began from a practical visual starting point (precipitation reactions, preparation and properties of common substances). All of the experienced teachers thought practical chemistry signalled to students that chemistry was about making substances, testing their properties, identifying patterns, and making predictions.

Teacher F: "Chemistry should begin on the bench, not inside a textbook. It is essential in beginning chemistry to signal to students that chemistry is observable and real and not simply a theoretical study. Kids get turned off by the unobservable early on".

The experienced teachers didn't necessarily start at the same point each year.

*Question 2* How do you go about allocating time to the various aspects of your teaching programme? How has this changed, if at all, over time?

For the two younger teachers time allocation was very much a hit-and-miss affair. They felt they needed more guidance from the curriculum in this regard. The more experienced practitioners also allocated the amount of time according to the needs of their students and were very flexible in their approach.

Teacher E: "I teach it until it is taught and then I move on. You can't teach by the clock – chemistry is such an inter-related discipline that it shouldn't be taught in isolated topics or chunks anyhow."

Unit Standard Assessment and the inclusion of individual practical investigations had caused two teachers difficulties in allocating sufficient time to teach the core content at Form 6.



*Question 3 What have been the critical influences in the development of your teaching programme over the years?*

The younger, less-experienced teachers both cited student response and understanding as the critical influences in their first two years of teaching. They also suggested that their colleagues' expertise was important to them; "Confidence only comes with feedback, and my H.O.D. is very important in this regard" (Teacher D). For the experienced practitioners, the change in the nature of the senior school population with more students studying chemistry in Form 7 who have no intention of studying chemistry at tertiary level, and the influence of their colleagues were stated as being critical to the development of their teaching programmes. The curriculum had little or no influence.

Teacher F: "It's the courses that fired people up and got them going. We seem to be missing the good-quality in-service programmes these days and certainly the inspirational people just don't seem to be around. It's sad that it has all stopped. Magic and energy for teaching chemistry don't come through pieces of paper like curriculum documents – they come from good practitioners."

*Question 4 Achievement Objective 7.1 in the curriculum mentions the ways in which groups of related substances (like metals, detergents and fertilisers) interact with people and the environment. What sorts of things do you do to address this aspect of the curriculum?*

All those interviewed acknowledged the importance of linking the study of chemistry to the 'everyday world'. Three teachers chose to teach a 'topic' about environmental chemistry and attempted to link the theory to the student experiences as often as possible throughout their courses.

As Teacher E explained: "We really do this all the time. It is not new and the curriculum is merely restating what should be common practice. But I know it's not. The problem is that to make effective links for students the teacher must have a real interest and passion for the subject – read widely, find those extra resources, go to all the conferences. The problem is time, workload and, for me, motivation. There is so much change these days in the way education system is being structured and re-structured that I believe teachers are too worn out to keep on becoming more effective".

*Question 5 What do you see as being critical (i.e. the important dimensions) to a beginning chemistry course at senior secondary school level? Do you think the curriculum allows for this?*

This question relates closely to Question 1, but now the influence of the curriculum is introduced. All those interviewed were clear that CINZC contained all the critical dimensions for beginning a senior chemistry



course and that there was not restriction on where or how to begin.

Important dimensions mentioned included:

- a sense of fun, wonder, and relevance of things that surround you;
- things to which students can relate – chemistry must be given a global perspective and students need to be able to fit it into their picture of the world;
- predicting, observing and explaining practical work;
- understanding the fundamentals of a chemical reaction – what goes in must come out in a modified form
- being able to get a handle on what goes on in the physical world and adding a bit of excitement to their learning.

Two experienced teachers stated that the influence of Unit Standard Assessment in no way contributed to the students' enjoyment of the subject; in fact, they were having quite a de-motivating effect.

*Question 6    What do you understand by the term 'Sample Learning Contents' that is used regularly in the curriculum?*

The response to this question was unanimous. Without exception each teacher described contexts as familiar settings to which students can relate and on which they can base their learning. All were positive about using familiar settings to teach chemistry ("what teacher with common-sense would not do this anyhow?" – teacher D) but the most experienced teachers sent out a word of caution: "Contexts can be familiar but the chemistry associated with them is often complex, hard to put together for a student, and not that exciting anyhow. What is so magical about detergents?" (teacher F)

*Question 7    How would you like to change the curriculum so that you were able to teach the chemistry course that you really wanted to teach?*

Very little change in the curriculum was reported as being necessary to teach the 'ideal' course. Minor content changes were mentioned by two teachers and the most experienced teacher described the curriculum as a 'non-event' in terms of his current practice. This general level of satisfaction mirrors that found by the questionnaire.

*Question 8    Are there any barriers that prevent you teaching chemistry in the way you would ideally want to teach it?*

Lack of adequate resources, especially specialist equipment and teacher guide material, were mentioned by the majority (4 out of 6) of interviewees as being crucial barriers.

Unit Standard Assessment was also mentioned by those teachers using this method of assessment (3 out of 6) as being more of a hindrance

than a help; they “did nothing to promote high standards or excellence in chemistry” (teacher B). Large class sizes were also mentioned as a significant barrier to effective teaching.

*Question 9      What do you think are the most urgent needs of chemistry teachers currently?*

The most serious concern again related to work-load and the tired, uninspiring teaching that results. The demise of “the exciting old times when chemistry teachers used to get together regularly and discuss teaching and learning seems to have all but disappeared” was stated by teacher F. He went on to say “Teachers are battling too much on their own, especially when they are confronted with documents they have no idea what to do with. We need to get things going again with local networking.”

This parallels the request from the two inexperienced teachers for some more guidance from the local experts and enthusiasts. They both mentioned the “tired” nature of the chemistry teaching force and the definite need for “an injection of life”. Teacher A, who was responsible, at the time of interview, for organising professional development meetings for teachers, was saddened by the extremely poor turnouts for several after-school meetings he had organised. In a region with over fifty practising chemistry teachers, the highest number he could attract to any meeting was eight. New and exciting resources were also stated as an urgent need.

*Question 10      What do you think the curriculum should provide for teachers and should it influence the way in which chemistry is taught? Who or what should influence the way in which chemistry is taught?*

There was universal agreement that a curriculum should provide:

- a flexible yet structured course with clearly defined outcomes of learning (clear standards), an indication of the depth of treatment, and plenty of helpful suggestions especially for resources;
- a teacher’s guide that “fleshes out” the framework and suggested learning experiences.

The curriculum should influence the way in which chemistry is taught since it is supposedly based on sound research and best practice.

Teacher D: “There is certainly not one way to teach this subject. The curriculum should indicate that there are many teaching strategies and approaches to learning and I think the curriculum does this very well.”

Teacher F stated that “We all must influence the way in which chemistry is taught. Haven’t we all had the opportunity to feed into the

curriculum review process anyhow. We must keep curriculum development dynamic by the cross-fertilisation of ideas. I fear for this part of our profession”.

*Question 11 How well do you think the curriculum has been introduced into schools? What would assist its implementation?*

A unanimous negative response was given to the way in which the curriculum was introduced into schools. The lack of associated in-service, teacher guide material, and resources such as practical guides and computer-based materials were stated as being serious links missing in the curriculum development chain.

Teacher A: “The impetus to drive change is coming from nowhere. It is all very well sending a document to all schools in New Zealand without professional support. Much of the material in *CINZC* is excellent, but there is very little resource support. This a real Clayton’s implementation if ever there was one. All the teacher development work associated with the implementation of *Science in the New Zealand Curriculum* was great but science is not chemistry and chemistry teachers do have different needs. Not even one miserable teacher’s guide!”

Teacher F once again suggested that sharing of expertise was critical to improving standards of teaching and learning in chemistry and that is not being done at the local level. “This involves time and energy and at the moment teachers are worn to a frazzle.”

All those interviewed expressed a willingness to participate in curriculum development programmes if the timing was sensible. The implication seemed to be that a busy teaching term is not the best time and more use could be made of term breaks.

## Summary

The backgrounds of the teachers selected for interview did not resemble the backgrounds of those who responded to the questionnaire. Those interviewed were more experienced and had spent nearly all of their teaching years in Christchurch. Their level of experience, involvement in local professional development, and willingness to challenge and try out new ideas were the main reasons for their selection. It would be reasonable to describe the sample chosen as an unrepresentative cross-section of the chemistry teaching community. However, they were all well known by the researcher for their openness and contributions to previous curriculum and assessment debate. They would not be described as conservative or lacking in initiative.

One interesting aspect of the responses made by all those interviewed was the level of unanimity on questions relating to the curriculum document. They were generally satisfied with the structure and content of *CINZC* and suggested very little change would be required to allow a teacher to design an 'ideal' course. All commented on the definite improvement the inclusion of subject matter had made to teacher confidence compared to other curriculum statements. Lack of suitable resources and the uncertainty with national assessment policy were described as being the major impediments to teaching the 'ideal' chemistry course.

Two teachers had been extensively involved in trialling chemistry Unit Standards with their Year 12 classes. Both were very frustrated about the level of uncertainty in school assessment and had no confidence in the new standards-based approach. They felt the proportion of classroom time spent assessing students had increased considerably, leaving no time to plan for curriculum change. The de-motivating effect Unit Standards were having on students was of particular concern to these teachers but of even more concern is the de-motivating effect Unit Standards appeared to be having on teachers.

The most important influence in the development of teaching programmes was clearly that of other teachers. Teachers talking within schools and between schools affected change more than anything else. All those interviewed agreed with the philosophy expressed in *CINZC*, in particular the specific emphasis it placed on practical work and making chemistry relevant to the world of the student. Most suggested, however, that if *CINZC* is to have impact in schools then a coordinated programme of teacher development must accompany implementation. Teachers need to have the opportunity to engage in the proposed curriculum changes by sharing ideas and planning in a cooperative fashion if any actual changes are to eventuate. Most importantly, government-funded resources need to be produced to accompany teacher development programmes.

According to two of the most experienced practitioners, the most urgent need of teachers currently is local networking. The considerable change that has occurred in schools in the past decade has resulted in a tired and rather uninspired workforce which does not get together often enough to talk about the important issue of how to make chemistry teaching as interesting as possible. The poor attendance at after-school and evening meetings specifically designed for chemistry teachers does not bode well for effective curriculum development and teacher change.

The purpose of a curriculum, in terms of what it should provide for teachers and influence the way a subject is taught, was clear to all those interviewed. The curriculum should allow for flexibility in programme design and yet have sufficient structure to indicate learning outcomes, depth of treatment, and resource suggestions. Resources need to be

detailed for easy access and a variety of teaching approaches need to be described. The process of curriculum development will only be kept dynamic by the cross-fertilisation of ideas amongst all those with an interest in school chemistry. This group should not be restricted to school teachers but should include people from universities, polytechnics, industry, and the Ministry of Education.

The manner in which *CINZC* was introduced into schools was universally criticised by all those interviewed. Although much of the material in *CINZC* was described as excellent, the lack of supporting resources, both written and human, were clearly identified. The younger teachers felt unsure about how they were going to adapt their teaching programmes so that the specific emphases of *CINZC* could be included. They needed more guidance than a written curriculum statement.

## CHAPTER 4

### SUMMARY CONCLUSIONS AND RECOMMENDATIONS

The following conclusions relate to the research questions posed in the introductory chapter on page 9.

#### 4.1 Usefulness of *CINZC* to the classroom teacher

Although teachers agree with the philosophical directions suggested in *CINZC*, it is of limited use to them in planning, assessing and teaching their programmes of work. If the curriculum is to be considered the driving force of teaching and learning chemistry, it needs to be used as a **catalyst to initiate teacher discussion**. Teachers need the opportunity to try out and evaluate the suggested Learning Experiences, create teaching sequences using meaningful contexts, debate different teaching strategies and approaches, and share ideas about useful resources.

#### 4.2 Differences in the level of support for *CINZC* from teachers with different backgrounds

The differences in the responses by males and females were perhaps the most important and disturbing findings of this evaluation. Statistical comparisons of male and female responses to the 23 'value scale' questions revealed significant differences in almost half of the cases. Males were generally less supportive of the suggested teaching directions, found the document less useful for planning, assessing and teaching purposes, and reported less success in implementing the curriculum.

Gender differences were also obvious in the comments made on several questions where females tended to be constructive and positive, and males critical and negative. If the findings of this evaluation are typical, then difficulties in curriculum development could lie ahead for schools with a predominantly male teaching staff or schools where males dominate management positions; for example, Heads of Department or those holding positions of responsibility.

The results suggest that females are more willing to accept new ideas, are more flexible in their approach, and are generally more optimistic in their outlook on chemical education. The reasons for these differences are beyond the scope of this evaluation, but certainly offer further research opportunities.

In terms of age group differences, the polarisation of views was less obvious. The most negative responses came from the oldest age group (>50) whereas the most positive responses came from the youngest age group (21-30). Since many of the younger teachers would have used the curriculum to plan their first teaching courses as well as analysing and discussing *CINZC* during their teacher training, this result is not surprising.

The 'school gender' differences were not surprising given the staffing balance of females and males in those schools. This highlights the importance of cross-fertilisation of ideas and dialogue amongst teachers from different schools in the curriculum development process.

In larger schools, with more staff, sharing of ideas can occur on a regular basis. It was not surprising therefore that larger schools generally responded more positively to the questionnaire than smaller schools.

### **4.3 Implementation of *CINZC* and teacher change**

Although 80% of all respondents reported being either 'very positive' or 'positive' about *CINZC* being the platform for teaching and learning chemistry, this did not translate into successful implementation in schools. The curriculum had been in schools for over two years prior to this evaluation and yet over 25% of respondents reported little or no change in their teaching programmes. Further, less than 20% of respondents reported 'very successful' implementation into their schools.

This limited 'success' rate is directly related to the very limited professional development opportunities and resources provided for teachers. If teachers are to change, and if that change is to be effective, support and external assistance are essential. Teachers must be engaged in debate and discussion about curriculum change and plan for change in a collaborative way. Collaboration must occur within schools and, more importantly, between schools.

A well-planned programme of teacher development must accompany curriculum change if the direction of teaching and learning in chemistry is to evolve in an effective and meaningful way. The findings of this research support Bell's (1993) earlier work on teacher development.



#### 4.4 Barriers to successful implementation of *CINZC*

The most critical barrier to successful implementation was reported to be the lack of time available to teachers to plan for the suggested changes. Lack of resources, lack of professional development opportunities, and the influence of standards-based assessment were also significant impediments to change.

The considerable changes demanded by the *New Zealand Curriculum Framework*, combined with the recent changes to the national qualifications and assessment systems, has resulted in a tired, sceptical and rather pessimistic teaching workforce. Any change in curriculum is now treated with considerable wariness. The overall mood expressed by the teachers interviewed was not one of enthusiasm or excitement about the future. It would appear that there is a real need for leadership in professional development programmes in chemistry.

The proposed assessment changes for the year 2001, when <sup>a</sup>new system of 'achievement standards' will be introduced, are not going to support the incorporation of the suggested changes in teaching approach outlined in *CINZC*. The 'breathing space' that two of the most experienced teachers in the interviews asked for is simply not going to be available. There is a very real message here for policy makers. Unless the pace of change is checked and teachers are given sufficient time to work with and engage in the proposed changes, then the success of the changes is likely to be limited.

#### 4.4 Personal Reflections

As one of the coordinating writers of *CINZC*, the results of this research were of considerable interest. It was pleasing to find the great majority of respondents agreed with the directions the curriculum is suggesting. While the format of any document can be improved, it was also pleasing to find most respondents supporting the layout and organisation of the curriculum, especially the manner in which the content had been organised.

I suspected that *CINZC* would be of limited use to teachers unless it was accompanied by written resources and, more importantly, a well-organised teacher development programme. My suspicions were confirmed.

The most disturbing findings related to the general malaise that seems to be present in certain sections of the chemistry teaching community. The extent of the gender differences was quite surprising and very concerning. The differences in age group responses could have been expected, but not the polarisation of male and female views. A considerable amount of further research is needed in this field.

## 4.6 Recommendations

The following recommendations are supported by the evaluation.

1. The initial promise made by the curriculum division of the Ministry of Education, that a government-funded teacher's guide for *CINZC* be published and distributed to all schools, should be honoured. The guide could include:
  - (i) References and resources required for all suggested practical work.
  - (ii) Ideas for extended practical investigations.
  - (iii) A comprehensive chemical safety section including a list of hazardous substances and potentially dangerous experiments.
  - (iv) More detailed assessment examples with model answers.
  - (v) Examples of teaching sequences that use a contextual approach.
  - (vi) Examples of year planners for each curriculum level.

A member of the original curriculum writing team should coordinate the writing of the guide.

2. A government-funded teacher-development programme in chemistry should be established, coordinated by regional advisory services, and involving facilitators who are recognised curriculum experts. One primary objective of this programme should be to establish regional networks of chemistry teachers. The programme should be ongoing and, eventually, sustainable without external funding. A nation-wide teacher development programme was carried out in 1993 to support the implementation of the science curriculum. It is now time to address the needs of the specialist sciences, such as chemistry. A teacher-development programme in chemistry should include:
  - (i) Clearly established objectives, especially for facilitators.
  - (ii) Collaborative planning amongst small clusters of proximate schools.
  - (iii) Resource materials, developed amongst cluster schools, and shared nationally.
  - (iv) Guidance on assessment methods.
  - (v) Video analysis of teaching strategies and examples of best classroom and laboratory practice.

3. Regular evaluation of the chemistry curriculum should be undertaken with opportunities provided to debate what chemistry is taught and how it should be taught. If the curriculum is understood to be the driving force of school chemistry, then teacher attitudes and willingness to change should be monitored through agencies such as the Education Review Office, advisory services, national and regional science teacher associations, in-service courses and conferences. The coordination of the monitoring should be the responsibility of the curriculum division of the Ministry of Education.
4. Further research should be carried out on gender differences associated with curriculum change in other learning areas. The education community needs to be made aware of differences in attitude towards curriculum change that are associated with teachers from different backgrounds.
5. Government funding should be provided for schools to develop or purchase new resources to enable them to implement *CINZC* effectively.
6. Updated information should be made available to teachers to keep them abreast of new developments in chemistry. In this regard it is important that strong links are maintained between tertiary institutions and schools.
7. Any future curriculum revision should not be accompanied by major structural changes in assessment systems. Any changes to the way in which chemistry is assessed in the senior school must be founded on *CINZC* and not current national examination prescriptions. Uncertainty about the direction of national assessment systems causes considerable pressures in schools and is not conducive to effective curriculum development.
8. The impact of future assessment changes on teacher workload and student learning in chemistry should be closely monitored and effectively researched.

## References

- Ausubel, D.(1969) Some Psychological and Education Limitations of Learning by Discovery. In: Andersen, H.O. *Readings in Science Education for the Secondary School*. Indiana University, The McMillan Company, p 97-114.
- Bell, B. (1990) Science curriculum development: A recent New Zealand example, in: *SAME papers*, Hamilton, NZ: Centre for Science, Mathematics and Technology Education Research, University of Waikato.
- Bell, B. (ed.) (1993) *I know about LISP but how do I put it into practice?* Hamilton, NZ: Centre for Science, Mathematics and Technology Education Research, University of Waikato.
- Bell, B., Jones, A. and Carr, M. (1995) The development of the recent national New Zealand science curriculum. In: *SAME papers*, 1995. Hamilton, NZ: Centre for Science, Mathematics and Technology Education Research, University of Waikato. p 3-44
- Bodner, G. (1986) Constructivism: A Theory of Knowledge. *Journal of Chemical Education*, **63**, 873
- Carr, M. (1995) in: *Responses to "Challenging N.Z. Science Education"* by Michael Matthews. University of Waikato, p11.
- Christiansen, G.S. and Garrett, P.H. (1960) *Structure and Change: An Introduction to the Science of Matter*, W.H. Freeman and Company, San Francisco.
- Clark, M. and Vere-Jones, D. (1987) Science Education in New Zealand: Present Facts and Future Problems. *The Royal Society of New Zealand Miscellaneous Series 15*, p 39.
- Department of Education (1987). *The Curriculum Review, Report of the Committee to Review the Curriculum for Schools*. Wellington: Government Printer.
- Driver, R. and Oldham, V. (1986) A constructivist approach to curriculum development in science. *Studies in Science Education*, **13**, p105-122.
- Fullan, M.G. (1991), *The New Meaning of Educational Change*, London: Cassell.
- Haig, M. (1995) The Achievement Initiative in Science: Developing Science in the New Zealand Curriculum. in: *SAME papers*, Hamilton, NZ: Centre for Science, Mathematics and Technology Education Research, University of Waikato, p 45-72
- Harland, P.W. (1991) The 7th-Form Chemistry Syllabus: Time for a Change? *CHEM NZ*, **45**: p 3-12.

- Hawkins, D. (1994) Constructivism: Some History. In: Fensham, P.J. *The Content of Science. A Constructivist Approach to its Teaching and Learning*. The Falmer Press, London, p 9-13.
- Irwin, M. (1994) *Curriculum, Assessment and Qualifications*. Prepared for the Education Forum. Wellington: New Zealand Business Roundtable.
- Johnstone, A.H. (1993) The development of chemistry teaching: A changing response to changing demand. *Journal of Chemical Education*, **70**, p 701-705.
- Mallison, G.C. (1975) A Summary of Science Education, *Research in Science Education*
- Matthews, M. (1995) *Challenging New Zealand Science Education*. Palmerston North: Dunmore Press.
- McGee, C. (1997) *Teachers and Curriculum Decision-Making*. Palmerston North: Dunmore Press,
- Merrill, R.J. (1969) Chemistry: An Experimental Science. in: Andersen, H.O. *Readings in Science Education for the Secondary School*. Indiana University, The McMillan Company, 1969, p 411-417.
- Oughton, T.J. (1995) The Development of Chemistry in the New Zealand Curriculum. *CHEM NZ*, **58**, p 35-36.
- Ramsay, P., Harold, B., Hwak, K., Kaai T., Marriott, R., and Poskitt J. (1990) 'There's no going Back': *Collaborative Decision-Making in Education*, Final Report: Curriculum Review Research in Schools Project, Hamilton, New Zealand: The University of Waikato.
- Schollum, B. (1992) Highlighting the Learning in Chemistry. *New Zealand Science Teacher*, **69** p 35-41.
- Tasker, R. (1994) Curriculum development in Science. *CHEM NZ*, Special Issue, February.
- White, R.J. (1988) Theory into Practice I. In: Fensham, P. *Developments and Dilemmas in Science Education*, The Falmer Press, London, p 121-132

## **Appendix I: Questionnaire sent to schools**

# **CHEMISTRY IN THE NEW ZEALAND CURRICULUM: AN EDUCATIONAL EVALUATION**

---

## **CHEMISTRY TEACHER QUESTIONNAIRE**

This questionnaire is to be completed by the HOD Chemistry or person responsible for the chemistry programme in the school. If any other chemistry teachers in the school would like to participate, please feel free to photocopy this questionnaire or contact the researcher so that additional copies can be forwarded. It is important that this questionnaire is completed on an **INDIVIDUAL** basis.

**The major purpose of this questionnaire is to determine**

- **the general level of support for, and interpretation of, "Chemistry in the New Zealand Curriculum" (CINZC);**
- **what, if anything, has changed from previous teaching approaches and learning programmes;**
- **what, if any, are the major barriers or tensions that might influence successful implementation.**

## **INSTRUCTIONS**

Please indicate your response to each question by:

- **ticking the appropriate box(es) or**
- **circling one of the numbers on a continuum, and/or**
- **providing comments where appropriate.**

Space has been provided for comment but if more is required, please use the reverse side of the appropriate page. If you feel uninformed about a particular question, please feel free to leave that question unanswered.

**Please Note:** You will need to have a copy of *Chemistry in the New Zealand Curriculum* with you when answering this questionnaire.

## CONFIDENTIALITY

Questionnaires will remain confidential to the researcher, and no individual school or person will be identified when reporting the results of the evaluation.

### Section One: BIOGRAPHICAL INFORMATION

1. Name: \_\_\_\_\_

2. School: \_\_\_\_\_

3. Gender: Male ☐ Female ☐

4. Age: ☐ 21-30 ☐ 31-40 ☐ 41-50 ☐ >50

5. Years of CHEMISTRY teaching experience:  
☐ 1-5 ☐ 6-10 ☐ 11-15 ☐ >15

6. What position do you hold in the school?

Part-time classroom teacher ☐

Full-time classroom teacher ☐

PR in chemistry ☐

HOD Science ☐

7. Besides senior chemistry, what is your second major teaching subject?

☐ Science ☐ Mathematics ☐ Physics ☐ Biology ☐ Other



8. What is your highest level of **chemistry** achieved at university?

		Year passed
None	[ ]	
1st year	[ ]	_____
2nd year	[ ]	_____
3rd year	[ ]	_____
B.Sc. Hons.	[ ]	_____
M.Sc.	[ ]	_____
Ph.D.	[ ]	_____

9. Have you had any experience in chemistry-related careers outside teaching?

[ ]	[ ]
Yes	No

10. Over the past 3 years, what has been the average size of your Year 12 (Form 6) and Year 13 (Form 7) chemistry classes?

(a) Year 12	[ ]	[ ]	[ ]	[ ]	[ ]
	<10	11-15	16-20	21-25	>25
(a) Year 13	[ ]	[ ]	[ ]	[ ]	[ ]
	<10	11-15	16-20	21-25	>25

11. How satisfactory would you describe your school facilities (i.e. specialist laboratories, equipment, glassware, etc.) for teaching chemistry?

Highly satisfactory	5	4	3	2	1	Completely unsatisfactory
------------------------	---	---	---	---	---	------------------------------

12. Did you provide any feedback to the Ministry during the development of "Chemistry in the New Zealand Curriculum" (CINZC)?

[ ]	[ ]
Yes	No

Comment: \_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_

## Section Two: CURRICULUM EVALUATION

1. How would you describe your familiarity with *CINZC*?

I have read the document thoroughly	[ ]
I have read parts of the document thoroughly	[ ]
I have skim read the document	[ ]
I have skim read parts of the document	[ ]
I have not read the document at all	[ ]

2. The philosophy of the new chemistry curriculum is expressed on pages 6-16 of the document. To what extent do you agree with this philosophy in terms of your own teaching?

[ ]	[ ]	[ ]	[ ]	[ ]
Strongly agree	Agree	Not sure	Disagree	Strongly disagree

Comment: \_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_

3. How USEFUL have you found *CINZC* for **planning** your chemistry programme?

Very useful	5	4	3	2	1	Not useful at all
-------------	---	---	---	---	---	-------------------

Comment: \_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_

4. How USEFUL have you found *CINZC* as a **guide for assessment**?

Very useful	5	4	3	2	1	Not useful at all
-------------	---	---	---	---	---	-------------------

Comment: \_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_

5. How USEFUL have you found *CINZC* as a **guide to classroom practice**?

Very useful	5	4	3	2	1	Not useful at all
----------------	---	---	---	---	---	----------------------

Comment: \_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_

6. COMPONENTS OF THE CURRICULUM

How useful have you found the following **components** of *CINZC* for planning, assessing and teaching your chemistry programme?

(a) The "Achievement Aims":

Very useful	5	4	3	2	1	Not useful at all
----------------	---	---	---	---	---	----------------------

Comment: \_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_

(b) The "Achievement Objectives":

Very useful	5	4	3	2	1	Not useful at all
----------------	---	---	---	---	---	----------------------

Comment: \_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_

(c) The "Sample Learning Contexts":

Very useful	5	4	3	2	1	Not useful at all
----------------	---	---	---	---	---	----------------------

Comment: \_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_

(d) The "Possible Learning Experiences":

Very useful	5	4	3	2	1	Not useful at all
----------------	---	---	---	---	---	----------------------

Comment: \_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_

(e) The "Assessment Examples":

Very useful	5	4	3	2	1	Not useful at all
----------------	---	---	---	---	---	----------------------

Comment: \_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_

(f) The "Developing Scientific Investigative Skills and Attitudes in Chemistry":

Very useful	5	4	3	2	1	Not useful at all
----------------	---	---	---	---	---	----------------------

Comment: \_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_

7. To what EXTENT do you think *CINZC* has changed the subject matter/core

content (refer to the inside back cover of the curriculum) that has traditionally been taught?

Changed substantially	5	4	3	2	1	Not changed at all
--------------------------	---	---	---	---	---	-----------------------

Comment: \_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_

8. To what extent do you approve of the following emphases that curriculum suggests for teaching chemistry:

(a) The emphasis on practical investigation:

<input type="checkbox"/> Strongly approve	<input type="checkbox"/> Approve	<input type="checkbox"/> Not sure	<input type="checkbox"/> Disapprove	<input type="checkbox"/> Strongly disapprove
--	----------------------------------	-----------------------------------	-------------------------------------	---

Comment: \_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_

- (b) The emphasis on the interaction between chemistry and people and the environment:

<input type="checkbox"/> Strongly approve	<input type="checkbox"/> Approve	<input type="checkbox"/> Not Sure	<input type="checkbox"/> Disapprove	<input type="checkbox"/> Strongly Disapprove
--	----------------------------------	-----------------------------------	-------------------------------------	---

Comment: \_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_

- (c) the linking of chemical concepts and patterns of behaviour through appropriate contexts:

<input type="checkbox"/> Strongly Approve	<input type="checkbox"/> Approve	<input type="checkbox"/> Not Sure	<input type="checkbox"/> Disapprove	<input type="checkbox"/> Strongly Disapprove
--	----------------------------------	-----------------------------------	-------------------------------------	---

Comment: \_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_

(d) the completion of an extended practical investigation by Level 8:

☐   
Strongly  
Approve

☐   
Approve

☐   
Not Sure

☐   
Disapprove

☐   
Strongly  
Disapprove

Comment: \_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_

9. Considering the content areas described for Level 6 (Form 5):

(a) Is the amount of content described:

☐   
Too much

☐   
About right

☐   
Too little

(b) What, if any, content area(s) have been included that should not be?

Comment: \_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_

(c) What, if any, content area(s) have not been included that should be?

Comment: \_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_

10. Considering the content areas described for Level 7 (Form 6):

(a) Is the amount of content described:

☐   
Too much

☐   
About right

☐   
Too little

(b) What, if any, content area(s) have been included that should not be?

Comment: \_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_

(c) What, if any, content area(s) have not been included that should be?

Comment: \_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_

11. Considering the content areas described for Level 8 (Form 7):

(a) Is the amount of content described:

☐ Too much      ☐ About right      ☐ Too little

(b) What, if any, content area(s) have been included that should not be?

Comment: \_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_

(c) What, if any, content area(s) have not been included that should be?

Comment: \_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_

12. In the space below, list what you consider to be the major **STRENGTHS**, if any, of *CINZC*.

\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_



13. In the space below, list what you consider to be the major **WEAKNESSES**, if any, of *CINZC*.

---

---

---

---

---

---

14. Which of the following influences is **PRIMARILY** responsible for determining your teaching methods/style in chemistry at:

(a) Year 12 (Form 6)?

<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
The	Examination	Previous	Unit	Other
curriculum	prescriptions	experience	standards	

Comment: \_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_

(b) Year 13 (Form 7)?

<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
The	Examination	Previous	Unit	Other
curriculum	prescriptions	experience	standards	

Comment: \_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_

- 
15. *CINZC* allows for reasonable flexibility in designing your chemistry programme. Would you prefer more, less, or the same amount of structure and guidance?

<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
More	Same	Less

Comment: \_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_

16. To what extent would you describe your own attempts to incorporate the philosophy and direction given by *CINZC* in your own teaching programme?

Substantial attempt	5	4	3	2	1	No attempt at all
---------------------	---	---	---	---	---	-------------------

Comment: \_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_

17. How successful have you been in implementing *CINZC* at your school? (i.e. developing school schemes from the curriculum.)

Very successful	5	4	3	2	1	Not successful at all
-----------------	---	---	---	---	---	-----------------------

Comment: \_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_

18. The following factors could obstruct the successful implementation of *CINZC*. To what extent have you found that these factors have affected implementation in your school?

- (a) Lack of adequate resources, i.e. texts, teachers' guides, equipment.

No effect at all	5	4	3	2	1	Critical effect
------------------	---	---	---	---	---	-----------------

Comment: \_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_

- (b) Lack of professional development opportunities.

No effect at all	5	4	3	2	1	Critical effect
------------------	---	---	---	---	---	-----------------

Comment: \_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_

(c) Lack of time.

No effect at all	5	4	3	2	1	Critical effect
---------------------	---	---	---	---	---	--------------------

Comment: \_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_

(d) Lack of belief in the direction and philosophy of the curriculum.

No effect at all	5	4	3	2	1	Critical effect
---------------------	---	---	---	---	---	--------------------

Comment: \_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_

(e) The influence of Unit Standards Assessment.

No effect at all	5	4	3	2	1	Critical effect
---------------------	---	---	---	---	---	--------------------

Comment: \_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_

19. Are there any other influences that have obstructed implementation of *CINZC* in your school?

Comment: \_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_

20. What changes would you make to *CINZC* to make it more suited to your needs?

\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_

21. Overall, what is your feeling about *CINZC* being the platform for chemistry teaching and learning in the senior school.

☐   
Very  
positive

☐   
Positive

☐   
Neutral

☐   
Negative

☐   
Very  
negative

Comment: \_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_

22. If there are any other comments you would like to make about any aspect of *CINZC* please add them below.

\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_

Thank you very much for your time and input.

Please return this questionnaire in the self-addressed, stamped envelope provided **as soon as possible**, preferably within 2 weeks.

If you have any questions about the survey please do not hesitate to direct your queries to:

Tim Oughton  
Christchurch College of Education  
P O Box 31-065  
Christchurch  
Ph: (03) 348 2059 ext 8066  
Fax: (03) 348 4311  
email: [tim.oughton@weka.cce.ac.nz](mailto:tim.oughton@weka.cce.ac.nz)

## Appendix II:

## Interview Questions

1. When you begin your sixth form course, what (topic/s) do you begin with and why do you begin there?  
How has this changed, if at all, over time?
2. How do you go about allocating time to the various aspects of your teaching programme?  
How has this changed, if at all, over time?
3. What have been the critical influences in the development of your teaching programme over the years?
4. Achievement Objective 7.1 in the curriculum mentions the ways in which groups of related substances (like metals, detergents, fertilisers) interact with people and the environment. What sorts of things do you do to address this aspect of the curriculum?
5. What do you see as being critical (i.e. the important dimensions) to a beginning chemistry course at senior secondary school level? Do you think the curriculum allows for this?
6. What do you understand by the term Sample Learning Contexts that is used regularly in the curriculum?
7. How would you like to change the curriculum so that you were able to teach the chemistry course that you really wanted to teach?
8. Are there any barriers that prevent you teaching chemistry in the way you would ideally want to teach it?
9. What do you think are the most urgent needs of chemistry teachers currently?
10. What do you think the curriculum should provide for teachers and should it influence the way in which chemistry is taught? Who or what should influence the way in which chemistry is taught?
11. How well do you think the curriculum has been introduced into schools? What would assist its implementation?

## Appendix III: Curriculum Strengths and Weaknesses

### 1. Curriculum Strengths

- Attempts to address relevance of subject matter.
- Its focus on practical work and the importance of investigations. Its promotion of chemistry in context, while at the same time not limiting the content.
- Do like emphasis of chemistry as a part of everybody's world and its subsequent importance.
- Clear indication of level of attainment, standards are clear. Learning experiences give suggestions to be incorporated in schemes. Little change from good practice used previously. Flexibility for local issues.
- Tries to make chemistry more relevant - but the "better" teachers were already doing this.
- Some ideas of what can be done. Reasonably loose to allow teacher innovation.
- Flexibility in Form 6. Emphasis on skills as well as knowledge. Emphasis on chemistry and society.
- Standard of concepts/content expected. Emphasis on practical investigations.
- Anything pertaining to good core content and emphasising of practical skills. Ideas expressed as learning experiences, assessment examples are great time savers.
- Don't feel that I know the document well enough to comment
- Well thought out. Good guide. The content area is clear at each level and lots of ideas are incorporated.
- At least it is easy to use. A bit wordy but is easily available.
- Doesn't say 'you must teaching this in this way'. I feel it allows creative chemistry teaching (preparation time is an issue however).
- Allows for individual schools and teachers to use their own flair, resources and interests.
- Philosophy, worthwhile, clear content areas.
- Puts in writing what many good chemistry teachers have already been doing.
- Its coherent look at chemistry education as a whole programme of learning in the senior secondary school.
- Reasonably well presented and structured document that can be used as a base for producing chemistry programmes.
- Fairly well laid out for beginning teachers.
- Description of content areas at each level. List of possible learning experiences. Assessment examples. Link between learning experiences and investigative skills on p 36-39.
- Suggestions for learning experiences.
- Reconsideration of teaching strategies. Greater variety of ways of presenting, especially. greater emphasis on pupil centred learning. Strong emphasis on relevance and activity.
- More flexible. Emphasises more practical work and greater student involvement/responsibility.

- Flexibility.
- Ensuring chemistry becomes more applicable to everyday situations in the business and manufacturing industry.
- Content is more clearly defined than in science document. Clearly written to offer chemistry teachers continuity.
- Emphasis on, and encouragement of, practical work.
- The follow through from level to level.
- Easy to follow format. Lists of examples.
- Far more specific document than the material world section of the Science in the New Zealand Curriculum. Content areas clearly spelt out.
- The document has made chemistry teachers think - especially about all the changes that many appear to believe are necessary.
- Able to give specific guidance in a subject usually governed by examination prescriptions. Extends beyond traditional knowledge base into practical and everyday problem solving.
- Fairly concise. Quite readable. It is more sequential/hierarchical than Science in the New Zealand Curriculum.
- Practical skills and investigations. Core content there but arranged contextually. Communication of knowledge focussed on.
- Compact presentation. Reasonably easy to “find” the bit you want.
- Has a more modern approach - should suit a wide range of student.
- To focus teachers on making chemistry relevant and practical.

## **2. Curriculum Weaknesses**

- No strengths or weaknesses. Same content revamped.
- No timing. Could provide better range statements.
- Too vague. Too much emphasis on practical work avoiding the difficult theory and “graft”. Too superficial in approach.
- Lack of adequate resources for ideas on relevant industrial applications and ideas for project work accessible and understandable by Form 6 and 7.
- Too vague, too little emphasis on chemistry of common compounds and families. Many students arrive at Level 8 not knowing what simple compounds like  $\text{CuSO}_4$  etc even look like, let alone properties and uses.
- Assessment at Level 8 for Bursary just doesn’t have the same emphasis as the curriculum document. Added to this is the drive to increase assessment using unit standards whilst maintaining Bursary.
- Does not provide teachers who are new to the system with enough guidance and warning about some of the danger associated with teaching chemistry
- Is another change necessary?
- Different areas of curriculum unrelated. Objectives and contents do not tie in well together. Skills and attitudes don’t tie in with objectives.
- Sometimes objectives are difficult to translate into teaching practice as wording is difficult to understand or objective too broad.
- Inclusion of extended practical by end of Level 8. I think there will be problems with students completing this, especially if their focus is Bursary. In Year 12, it means we will remove a research assessment.



- Possibility for too much time on 'waffle' with regard to people and environment. Chemistry too complex for school study. Lack of explanation.
- Everything is labour intensive and short on outcomes. Context idea is pushed too hard. Philosophy of teaching something to look at.
- Too general and vague.
- In some ways the freedom it allows is the biggest weakness - you get worried that you are not covering it properly then you end up looking at prescriptions i.e. become exam driven.
- Many headings of components are just management theory. Unhelpful/time-consuming.
- Too vague for Bursary. Covers too much.
- Learning experiences great but time involved is difficult to find when exam prescriptions have to be covered.
- Too many words. Some learning experiences not well thought through. Too much expected to be done in approximately 110 hours.
- Some areas low on practical examples, eg atomic structure.
- Inability to offer a tighter compulsory core (with reduced content) to allow for a little more choice in addressing interest areas or updated cutting-edge content. The relationship between science and chemistry at Year 11 is still a concern.
- Not enough information to back up ideas.
- Reliance on teacher experience to interpret document.
- Bursary marks dominate so prescription, not curriculum dominates. Curriculum may change but if the prescription does not, what is the point to change teaching style.
- Lack of exemplars
- Content can be very widely interpreted - this could be good - however possible learning experiences/assessment examples may be seen as prescriptive, although this is not the intent.
- CINZC appears to want chemistry to become a conglomeration of skills loosely attached to knowledge but implying that knowledge is of little value.
- To some teachers, more guidance needed on how to present aspects of curriculum. Communication with those designing examination prescription.
- Links to SNZIC not always clear/accurate.

#### **Appendix IV:      Comments on other influences that have obstructed implementation of *CNZIC***

- Class size, time given to subject.
- External exams have not so far presented prescription to be implemented for *CINZC*.
- Getting on with the job and just doing it.
- Just general workload and uncertainty in NZQA framework . Hang on to the old schemes until change is settled on.
- Lack of access to technology.
- Lack of time, no effort from others in science department on scheme writing.
- Lack of time.
- Not being examined until 1998 so why teach it in 1997.
- Only time to implement change and resources (money) to introduce more varied practical investigations (chemicals also cost money).
- The contexts chosen may not suit all teachers.
- Time - or lack of it.
- Too much change too soon - school has modularised and introduced Achievement Based Assessment in past 5 years.
- Bursary exam.
- Doing OK with present curriculum
- Implementation gone on despite negatives but may dry up with lack of resources.
- Lack of finance.
- No established model to follow - or I have no access to one. Not sure what we "should" be doing.
- NZQA and their changes.
- Other classes which absorb a great deal of time due to disruptive behaviour.
- Parent/public expectations and requirements of external examinations.
- Time.
- Uncertainties in the curriculum area. Don't want to rush into areas that will change in a short time.

**Appendix V:        Comments on changes that would make *CNZIC*  
more suited to respondents' needs.**

- Not taught a programme fully based upon it yet.
- I believe in exams at Forms 5 and 6. Unit Standards are far too burdensome and stifling to the creativity of chemistry teachers.
- Provide teaching/assessment resources. Selection would allow courses to be flexible but supported.
- Greater practical influence.
- Would appreciate some more 'spoon feeding' of ideas and approaches to be tried.
- None - flexibility possible.
- Rambling assortment of assessment and learning examples better organised and linked to objectives and contents. Clearer indication of the depth of treatment and approximate timing of each area. Clearer separation of core and peripheral activities. Clearer separation of objectives at Levels 6,7, and 8.
- Teacher only days with experienced teachers invited to help wade through *CINZC*, Science. in the New Zealand Curriculum., physics, biology and technology documents. Awful lot of planning involved.
- The extended investigation is a good idea but difficult to implement. How are we going to ensure it happens at Bursary level?
- Remove heavy emphasis on context-first theory-second and investigations.
- Go back to what we had before - a well structured course with a worthwhile exam at the end that tested pupils ability and demanded excellence.
- Some recognition of regional differences in terms of associated chemical issues, environmental concerns and type of society.
- Slightly more direction - however change too much and I would feel as if you were taking away my right to decision making.
- Every idea, resource and information contained - ideal. Too vague for new teachers.
- Happy with it in general but would do a better, more focussed job given more time and better support systems.
- Add some real information regarding assessment examples and learning experiences.
- Development and implementation of a Form 6 chemistry prescription based on *CINZC* document.
- Unit plans I write from the curriculum do this. Plenty of flexibility. Teacher training/writing days have been of great assistance to guide and support.
- Help if it were more dogmatic and gave full examples. eg a context and how it can be used or a whole school programme.
- More exemplars and support material.
- *CINZC* is fine. What I need now is someone to write a context based textbook which fits a modular (6 week) course with practical manual and teachers guide.
- Greater elaboration of all content. Definite ranges of material to be incorporated. Production of a document that is professional.
- Sort out the assessment methods.
- I love it! Perhaps more time allocation for major research to be developed over 2-3 years, implementing concepts developed in this time.